POPULAR SCIENCE

FOUNDED MONTHLY 1872

SM

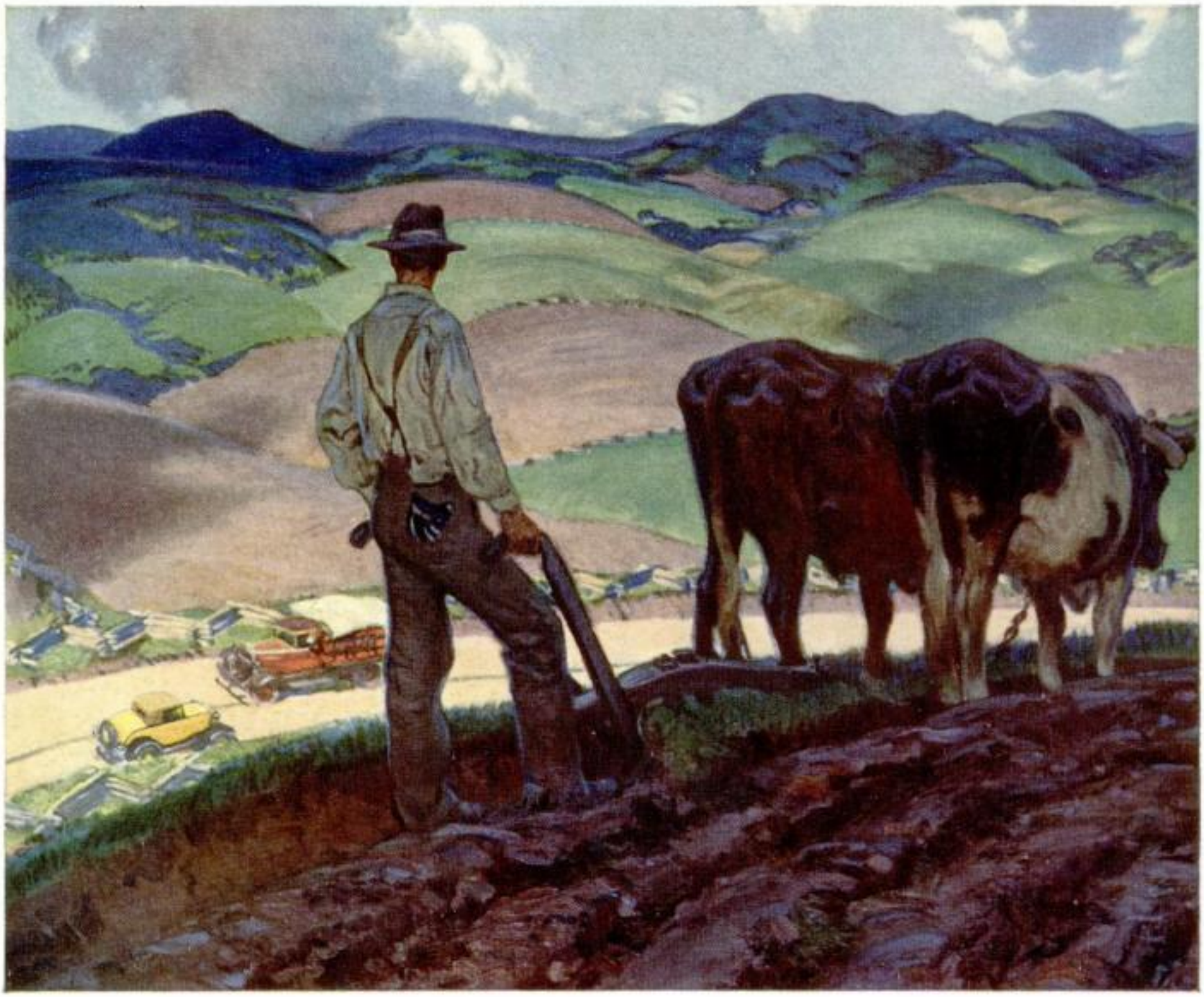
NOVEMBER

25 CENTS

30 CENTS IN CANADA

SLEEPING VOLCANO FLAMES AT TOUCH OF ELECTRIC KEY

Page 25



GROUNDWORK

"Mankind passes from the old to the new on a human bridge formed by those who labor in the three principal arts—agriculture—manufacture—transportation"

THESE WORDS are carved above the doorway of the Ford Engineering Laboratory. That they are not idle poetry must be plain to all who have driven over the country roads of America. For everywhere swift, economical transportation is freeing the chained energy of the nation as heat releases imprisoned energy.

Much of the nation's natural wealth still remains buried and impotent waiting for new roads and swift transportation to awaken them to life and usefulness. The hands of the producer of raw materials, the maker, and the carrier still have immeasurably profitable work to do when they learn to co-operate.

The Ford car was planned with the idea that growth and progress are in the hands of all the people, and not of any specially favored class. If an economical means of dependable rapid transportation could be placed at their disposal, it was believed people of moderate means would recognize its value to them individually, and use it.

To date, over twenty million Fords have rolled out of the factories to run incalculable miles over the face of the earth doing service to mankind in a thousand ways!

The Ford today is as naturally a domestic factor in American private life, and in American business, as the horse was in another generation. The Ford car opens up the country to all! And business of every kind moves at a more productive pace because of it.

FORD MOTOR COMPANY

Announcing sensational new

RCA Victor Radio-Phonograph

Featuring new record that plays 30 minutes, (about 4 times as long as present type) and SIX other revolutionary developments . . . all at the former price of a radio alone!

1

New 10-tube De Luxe Super-Heterodyne Radio with Pentode Tubes and Automatic Volume Control.

2

New electrically recorded and amplified phonograph music.

3

New automatic record changer—that will play ten records as long as you like.

4

New long-playing records—15 minutes of music on each side, or half hour per record.

5

Marvelous home-recording apparatus with studio-type microphone—so you can make 10-inch records of your own voice.

6

New chromium needles—good for 100 playings—also improve tone.

7

New acoustically balanced cabinet—carefully designed for fine tone effect.

The New RCA Victor Radio-Phonograph, Model RAE-59, Price $350

All you do is select the records . . . the mechanism does the rest . . . 40 minutes of music from present type records . . . 2½ hours—almost four times as much—from new long-playing type. Machine also plays individually any record you now own.

TODAY . . . a glorious new type of home entertainment is here! Today with the new RCA Victor radio-phonograph, you have at your command not only America's $70,000,000 worth of broadcasting programs—not only a $500,000 library of the world's finest music—but also—you can now enjoy *two and a half hours* of record music without touching the instrument.

You can now enjoy a marvelous new type of record that plays 15 minutes on each side—30 minutes in all. A record far more true in reproducing tone.

You can now enjoy a new RADIO—a 10-tube De Luxe Super-Heterodyne—the finest RCA Victor radio ever made. It employs the new RCA Victor Synchronized Tone System, affording radio entertainment heretofore considered impossible.

A new type of record changer is here, too! . . . capable of playing any 10 regular-size records as long as you desire—with no effort on your part.

A new type of phonograph is here with a new method of electrical amplification—almost uncanny in its realistic effect. And all these features come to you in this new instrument for $350—about *half* the former price! By all means, hear the new radio-phonograph at your RCA Victor dealer's today . . . hear the new long-playing records . . . and hear the many other new RCA Victor instruments . . . radios from $37.50 to $179 complete . . . combinations from $114 to $995.

RCA Victor Co., Inc. "RADIO HEADQUARTERS"
Camden, N.J. *A Radio Corporation of America Subsidiary*

RCA Victor

RADIO PHONOGRAPH-COMBINATIONS
VICTOR RECORDS

25 Cents a Copy
$2.50 a Year

POPULAR SCIENCE MONTHLY

381 Fourth Avenue
New York, N. Y.

Table of Contents for November, 1931

LEADING ARTICLES

FEATURES AND DEPARTMENTS

ASTRONOMY

AUTOMOBILES

AVIATION

MODELS

November, 1931, Vol. 119, No. 5. **Popular Science Monthly** is published monthly at 381 Fourth Avenue, New York, N. Y., by the Popular Science Publishing Co., Inc. Entered as second-class matter Dec. 28, 1918, at the Post Office at New York under the act of March 3, 1879; additional entry as second-class matter at Dayton, Ohio. Entered as second-class matter at the Post Office Department, Canada. Printed in U. S. A. Copyright, 1931, by the Popular Science Publishing Co., Inc. Single copy, 25 cents (30 cents in Canada). Nine months' subscription in U. S., $2. Yearly subscriptions to United States and its possessions, $2.50; foreign countries, including Canada, $3. The contents of this magazine must not be reprinted without permission. The editors are not responsible for unsolicited contributions, and cannot guarantee the return of such material or insure against its loss. In presenting numerous stories of new products of applied science, **Popular Science Monthly** does not underwrite the business methods of the individuals or concerns producing them. The use of **Popular Science Monthly** articles for stock-selling schemes is never authorized. A. L. Cole, President and Treasurer; R. C. Wilson, Vice President; John Nichols, Vice President; F. W. Briggs, Secretary.

Popular Science Monthly for November, 1931

INSURANCE *that Pays off your* MORTGAGE

By LEON MEADOW, *Financial Editor*

IT WAS getting uncomfortably hot in Osborne's office. Jerry Sloan, the insurance man, wiped a moist brow with a moist handkerchief. He had "cracked" many a tough nut in his day—but never had he come up against anything like this fellow Osborne. As immovable as the Rock of Gibraltar, Jerry told himself—and just about as hard-boiled as they come.

Now, after thirty minutes of getting nowhere, he was ready to give it up and call it a day as far as this prospect was concerned. He had tried every insurance appeal and argument he ever knew—and Jerry was by no means a poor salesman—but this time he was ready to admit defeat. Osborne had met or side-stepped every logical point he had made—and, as a matter of fact, Jerry expected to get thrown out of the office any minute now.

"Well, Mr. Osborne, I guess you just don't need any insurance," he said, rising from his chair and moving toward the door.

"If you had any brains, young man, you would have realized that twenty minutes ago, instead of wasting my time up till now," Osborne replied, indicating with his hand that the interview was over.

Sloan reached the door, opened it and then turned around, grinning broadly. "Of course," he said, "you wouldn't be interested in covering the first mortgage on that home of yours, so that no matter what happened the house would always be secured for you or for your wife and family." Jerry's smile died a quick death as he saw Osborne's face grow red. Now, he thought, Mr. Hard-boiled is certainly going to throw me out of here.

FORTUNATELY Jerry was wrong. Osborne, on the point of telling him to mind his own business and get out, suddenly changed his mind. "Come back here, Sloan, and sit down," he said quietly. "I don't know whether you know it or not, but you touched me on one of my few soft spots that time. You, and a lot of other insurance men, probably think I'm a pretty tough customer. That isn't so; I place as high a value on the need for insurance as anyone does. But, I happen to be carrying all the insurance I need, and there's not a reason in the world why I should overload myself, regardless of what any agent thinks. This time, however, you've mentioned something in which I'm tremendously interested. In my mail this morning was a note from the bank—semi-annual interest on my first mortagage is due again. That reminder started me thinking about a subject that has been on my mind ever since I made the first interest payment on this mortgage. And now, you come in and mention the same thing."

"Before you continue, Mr. Osborne," interrupted Jerry, "let me make a confession. You'd be right in thinking that this first mortgage was none of my business, and you're probably wondering how I found out about it. For the last three—"

"Don't bother," said Osborne. You probably got your facts from the bank, not that I care very much—mortgages are more or less public information. What I'm interested in—and what's always troubled me—is exactly what you mentioned just before—coverage on my mortgage. If anything happens to me, I'd like to know that I'm leaving my wife and children a home that is absolutely free and clear of all debts and obligations, other than taxes, of course. Now, young man, what's your story?"

"SIMPLY this, Mr. Osborne," Jerry began, "my company will provide you with a contract to cover your entire first mortgage which, I believe, is $10,000."

"That's right."

"But get this straight, Mr. Osborne,—you're not borrowing money for this protection—you're *buying it!* And it will cost you a very small percentage of the $10,000 face value of the contract to do so."

"Why don't you call it insurance and be done with it?" interrupted Osborne.

Jerry grinned. "Very well, sir, we'll call it insurance, since that's what it is, of course. I find that most men listen more readily when I leave out the word 'insurance' in my discussions. But that's all beside the point. Whatever you call it, this arrangement will meet your requirements perfectly.

"To repeat, you pay a certain percentage each year—and we accumulate your dividends for you at compound interest—to buy this $10,000 contract. By the way, this accumulation of dividends amounts to almost $1,500 in fifteen years, and nearly $2,500 in twenty years. At your death, we'll pay this $10,000 plus dividends, or $20,000 should it occur through accident before you're 70, and while the contract is still in force. So that, should this mortgage still remain a full $10,000 at your death, we guarantee to pay it off completely, turning over the additional dividends to your wife or family. On the other hand, if you have reduced the mortgage to, let us say, $7,500, we'll pay this amount and turn over the balance of $2,500 plus to your wife—a very material help.

"As you said before, you wish to leave your family a home that is free and clear of debt. Many men have wisely bought this contract for the same reason. But there's another angle to it that should

(Continued on page 6)

ELECTRIC LIGHT WITHOUT WIRES!

The Eveready Wallite brightens out-of-the-way corners, without the expense of wiring

Now you can have electric light, whenever and wherever you want! Handsome, pull-chain lights. Richly finished in black or ivory, and trimmed with polished, lacquered brass. No connections to make. No fuses, plugs, or wires. The Wallite, one of the wonderful, new Eveready *Wireless-Electric* Lights, is permanent or portable — whichever you want. Put it in place with two little screws, or hang it on a nail or hook.

Closets, stairways, attics, garages, and back-porch steps are only a few of the places where you need Wallites. They'll keep you free from the fear of fire, and the bumps and bruises that always lurk in the gloom and murk of poorly lit places.

Two of the *new* Eveready *extra long life*, metal-seal Batteries supply power for the Wallite. A set of renewal batteries cost only twenty cents. Get several Eveready Wallites today. At all good hardware, drug, electrical, department and auto-accessory stores. Only $1.75, complete.

•

THE NEW EVEREADY *extra long life* BATTERY has a metal-seal top instead of the old-fashioned wax seal. This all-armored construction locks the power in. More hours of light than ever! Be sure you get these powerful, *new* batteries. Ten cents everywhere.

EVEREADY
WIRELESS-ELECTRIC
L I G H T

NATIONAL CARBON COMPANY, INC.
***General Offices:* New York, N. Y.**
Unit of Union Carbide UCC *and Carbon Corporation*

BUY YOURSELF $200 A MONTH

...as long as you live

THE PROVIDENT PROVIDOR

(Issued only to men under 55)

FOR YOU it provides a guaranteed retirement income of $200 a month beginning at age 60 or 65 and continuing as long as you live. Total payments of at least $20,000 are guaranteed, although double that amount or more may be paid depending upon your length of life.

You can arrange for a Provident Providor which will pay you from $50 to $2500 a month. If you desire, a cash sum may be substituted for the income feature at the maturity of the contract.

FOR YOUR WIFE and children, or other dependents, it provides $20,000 in cash, payable in the event of your death prior to the maturity date. An especially attractive feature of the Provident Providor is that you may select a somewhat reduced income at age 60 or 65 with the guarantee that the Company will pay an income to your wife *and* yourself as long as either shall live.

A HELPFUL PROVISION. The difficulty with most savings plans is that they come to an end in case you are disabled. The Provident Providor overcomes this handicap by guaranteeing to pay all premiums for you during prolonged total disability which occurs before the age specified in the contract.

AN ILLUSTRATION For a premium amounting to less than $60 a month a young man of 35 can obtain $200 a month starting at age 65, and insurance protection of $20,000 until he reaches that age. Furthermore, he will be entitled to such annual dividends as are allotted from the Company's earnings. These dividends not only *decrease* the annual premiums considerably, but other dividends declared after maturity will *increase* the monthly payments to you.

TODAY, while you are insurable and can spare the money, let us show you how small an annual premium deposit will put the Provident Providor into action for you and yours. Protection starts at once.

Provident Mutual

Life Insurance Company of Philadelphia, Penna.

Founded 1865

Mail this Coupon NOW!

PROVIDENT MUTUAL LIFE INSURANCE CO.
Philadelphia, Pennsylvania

Please send full information and quote premium rate for a monthly income of $_____. It is understood that this places me under no obligation.

I was born _____
Month *Day* *Year*

My name is _____

Home address _____

Business address _____

7-P. S. M.

Insurance that Pays off Your Mortgage

[*Continued from page 4*]

also be considered. It often happens that the family income is considerably reduced after the death of a husband—and his widow feels that the home is then too big and too expensive to maintain. In that case, she may be anxious to dispose of it. In selling it she naturally receives only the amount it brings in excess of the first mortgage, and second mortgage, if there is one. Whereas, if the husband has taken out one of these contracts to pay off that mortgage, she can sell the house, if she so desires, and realize the entire sales price for herself."

"That's all very well," interrupted Osborne, "but in most cases a house is more quickly and easily sold when it is mortgaged, because it then shows that a bank or building and loan company have already placed a definite valuation on that home. And then again, the real estate market may be extremely poor when she is left with this house, and she may feel that by holding on to it, she'll be able to get a better price for it in two or three years. What happens then?"

"This contract," Sloan replied, "is flexible and advantageous enough to cover those circumstances too. Say a man takes out a $10,000 contract when he's thirty, and then dies twenty years later. If he has left his dividends accumulate, the total amont due is about $12,500. If his wife decides to let the mortgage stand, our company can arrange to keep this contract in the form of a trust for her, paying her a bit more than $600 a year interest—or sufficient to cover the annual interest on a $10,000 first mortgage, thus completely relieving her from all worries on that score.

"IN OTHER words, Mr. Osborne," Jerry continued, "this is insurance—but insurance that is taken out to fill a definite need. If that need never arrives because you have given up your home or paid off the mortgage entirely, it is still insurance. And, after twenty odd years, if you have let your dividends accumulate, it will be paid up insurance, covering you against death and disability over the entire period in which it remains in force. It may be, as I say, that when you reach the age of 60 or so—mortgage coverage, because of circumstances, will no longer be necessary. Then you may feel that you and your wife can best use this money for yourselves. In this event, cancel your contract, and we'll pay $10,500—approximately speaking—either in cash or in the form of an income, just as you wish."

"Contract—or insurance—or whatever it is, it's going to cost me something, so let's get down to figures." Osborne said.

"All right," Sloan replied, consulting a small black book of tables, "you are 30 years old now, aren't you?"

"That's right."

"Well then, simply consider that 6% rate of interest on your mortgage as being increased to 8.79%—and that will cover you completely, automatically paying off the entire amount of the mortgage at the time of your death."

"In other words," Osborne said, after a minute with a pencil and paper, "My cost is $279 a year and—"

"—and your worries, *nothing!*" interrupted Jerry. "Remember that as long as you carry a mortgage, there are always possible difficulties ahead for you or, worse, for your family. The beauty of this contract is the absolute elimination of any possible difficulties or loss—and, at the same time, it fortifies your later years with savings that have been scientifically managed."

Osborne started to answer, glanced at his watch and jumped up. "Say, you've already made me fifteen minutes late for an office meeting. Call me up next week," he said moving briskly out of the office, "and I'll give you my decision."

To Help You Get Ahead

THE booklets listed below will help every family in laying out a financial plan. They will be sent on request.

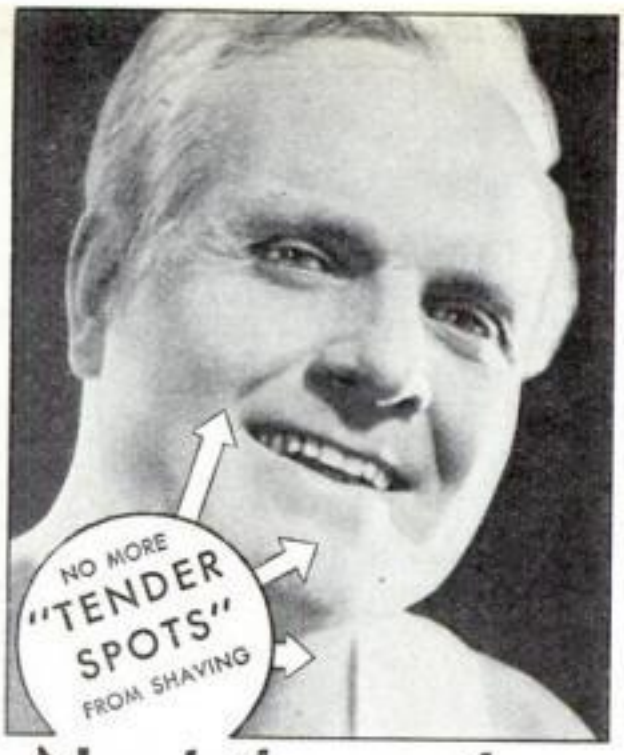
Your Income and Your Life Insurance is the name of a brief booklet scientifically answering the question "How much life insurance does a man really need?" Provident Mutual Life Insurance Company of Philadelphia, Pennsylvania, will mail a complimentary copy upon request.

Before 65 and After explains the full details of a Retirement Income, with full Life Insurance, Disability and Double Accident benefits. Sent on request by The Equitable Life Assurance Society, 393 Seventh Avenue, New York City.

How to Get the Things You Want tells how you can use insurance as an active part of your program for getting ahead financially. Phoenix Mutual Life Insurance Company, 328 Elm Street, Hartford, Conn., will send you this booklet on request.

Enjoy Money shows how the regular investment of comparatively small sums under the Investors Syndicate plan, with annual compounding of 5½% interest, builds a permanent income producing estate, a financial reserve for a business, or a fund for university education or foreign travel. Write for this booklet to Investors Syndicate, Investors Syndicate Building, Minneapolis, Minnesota.

See How Easy It Is tells how it is possible to start off with a definite plan for creating an immediate estate leading to future financial security. Get your copy of this booklet by writing to Postal Life Insurance Company, 511 Fifth Avenue, New York City.



New lather soothes ..ends razor scrape

TOUGH-WHISKERED, tender-faced shavers—*get this!* Here's a new lubricating lather that ends razor scrape—gives the world's best feeling shave.

Easy on tender spots—try it

Just lather with Lifebuoy Shaving Cream and shave in your old way. Notice how feather-light the razor feels on those tender spots that always used to sting and smart from shaving. Notice how the scrappiest whiskers come off without a fight—no painful pull—no harsh, smarting rasp—no after-irritation. That's because Lifebuoy lather *soothes, lubricates, protects.* Get the big red tube of Lifebuoy today! Or send for a free trial tube—to Lever Brothers Co., Dept. H-11, Cambridge, Mass.

HEAT ON THE SPOT FROM TUBES

STERNO CANNED HEAT

...NOW TUBED FOR THE HANDY MAN . . .

SQUEEZE a little STERNO under article to be heated, or on bent wire. Light. Instant heat guided by your hand for melting solder, glue; for mending, etc. Many uses for Sterno in Tubes in FREE booklet . . . at home, camp, in shop. Let Sterno help you. Large tube costs only 10¢. Use coupon.

STERNO CORPORATION PS-11
9 East 37th Street, New York

[ ] Send me your free booklet.
[ ] I enclose 10¢ for full-sized tube.

Name_____

Address_____

A definite program for getting ahead financially will be found on page four of this issue.

Presenting— A NEW RETIREMENT INCOME PLAN

THIS NEW PLAN has important advantages, such as: 1. Larger income and larger cash values, or 2. Reduced initial cost.

The plan provides a Retirement Income of from $60 a month to $600 a month, or even higher. This income starts at age 55, 60, 65, or 70, whichever you specify. It continues for life.

Suppose you decide to retire on $300 a month at 60. Here is what you get:

$300 a Month for Life

This $300 a month begins when you are 60 and continues for life. You are guaranteed a return of at least $30,000 and perhaps as much as $60,000 or more, depending upon how long you live. If you prefer, you may have at age 60 a cash settlement of $40,500.

$20,000 in Cash

In case of your death before age 60, your wife or other beneficiary is paid $20,000 cash, or as high as $40,500 cash, depending on how close to age 60 you are at death. If preferred, your wife is paid a monthly income for life.

$40,000 in Cash

Upon death from accidental means before age 60, $40,000 cash is paid to your wife, or as high as $60,500 cash, depending on how close to age 60 you are at death. Or, if preferred, the monthly life income for your beneficiary is correspondingly increased.

Income during Disability

If, before a specified age, serious illness or accident stops your earning power for a certain period, you thereafter receive a monthly income as long as such disability lasts, even if it lasts the rest of your life.

This Retirement Income Plan may be paid for in installments spread over a period of 20 years or more. Naturally, this makes the payments comparatively small. The Plan begins to operate as soon as you make your first payment. From that moment on, its benefits are guaranteed to you. Even if you should become totally disabled as described above and unable to make another payment, you would not need to worry. Your payments would be *made for you* by the Phoenix Mutual, an 80-year-old company with insurance in force of over 600 million dollars.

Send for This Booklet

A 24-page free booklet explains this new Plan. The booklet also tells how you can provide money to leave your home free of debt—money to send your son to college—money for emergencies. Send for your copy today. No cost. No obligation.

PHOENIX MUTUAL
LIFE INSURANCE COMPANY
Home Office: Hartford, Conn. First Policy Issued 1851

PHOENIX MUTUAL LIFE INSURANCE CO., 633 Elm St., Hartford, Conn.

Please send booklet giving me full information about your new RETIREMENT INCOME PLAN

*Name*_____ *Date of Birth*_____

*Business Address*_____

*Home Address*_____

INDEX
Guaranteed Advertisements

Popular Science GUARANTEE

POPULAR SCIENCE MONTHLY guarantees every article of merchandise advertised in its columns. Readers who buy products advertised in POPULAR SCIENCE MONTHLY may expect them to give absolute satisfaction under normal and proper use.

Tools, Radio Apparatus, Oil Burners and Refrigerators advertised in POPULAR SCIENCE MONTHLY have been tested or investigated by the Popular Science Institute of Standards and each advertisement carries the insignia indicating approval.

However, other products advertised in the magazine not subject to test carry the same guarantee to readers as products tested.

THE PUBLISHERS

THOUSANDS of MEN and WOMEN are Now Buying THE NEW BRITANNICA at a New Big Saving

THE present great reduction from the standard price of the Britannica, announced last month, is attracting unusual interest throughout the country.

We expected, of course, that many who have always wanted the Britannica would take this opportunity of securing it at a great saving. The response, however, to our announcement exceeds even our own expectations.

And it is more than ever clear to us that keen, progressive and prudent people will not neglect this present compelling offer to save money and own the Britannica.

The Incomparable Bargain

The exceedingly low price is possible because we have adventurously faced a temporary condition in the printing, binding and labor fields. It is only because we ordered a printing equal to the largest single printing of the Britannica ever made that considerable savings were realized in the production costs—savings now passed on to you.

At the time of going to press, orders were coming in thick and fast. In a comparatively short time, the printing, we believe, will be entirely sold out. Don't delay, therefore, if you wish to profit by the present low price. We frankly don't know whether business conditions will ever make such a bold reduction possible again.

It isn't surprising that so many people are investing in the Britannica. Its value is traditional, and this completely revised and rewritten 14th Edition represents the most progressive advance in its history.

It is an unrivalled source of practical information for the housewife, the business man, the lawyer, the doctor, the minister, the teacher, the child. It encourages the habit of independent research, the spirit of adventure in knowledge.

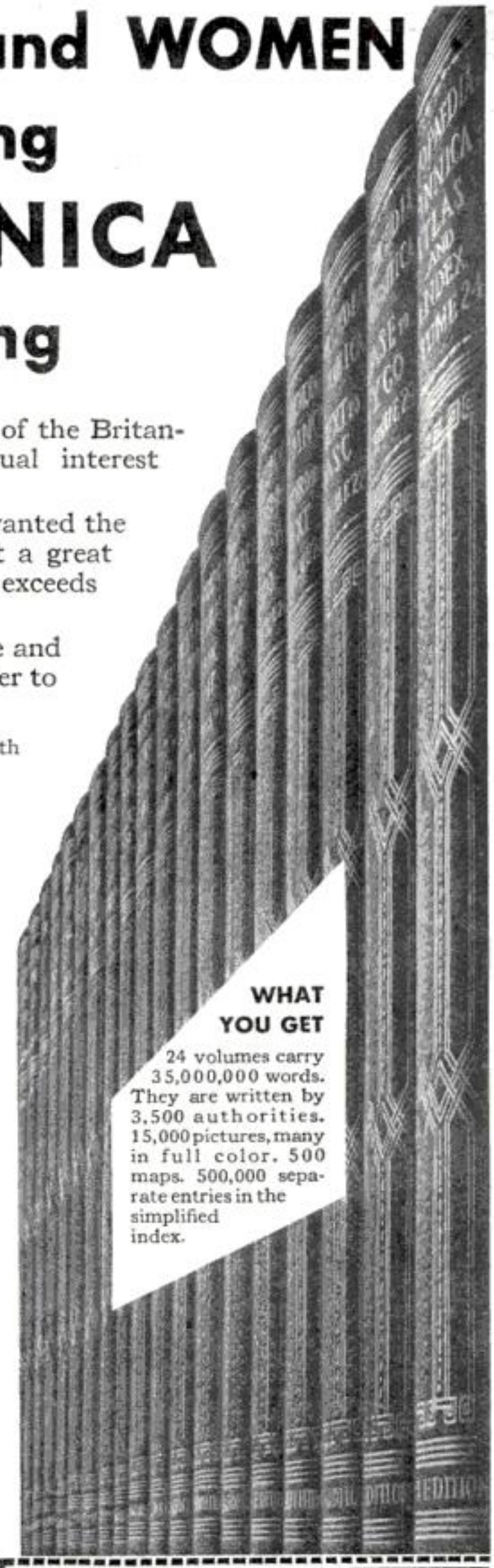
Highest General Authority

It brings authority to every human interest and is used profitably everywhere, and the need for it has never before been so vital.

We receive thousands of letters from heads of families who point with satisfaction to the day the Britannica came into their homes! These wonderful books never fail to help men, women and children when information, or indeed entertainment, is immediately needed. *And today is always the best time to buy them.*

Easy to own $5 down and only $5 a month

Our Thrift Plan favors the pocketbook. Only $5 down is required to bring the set to your home for immediate use. The balance is payable in a very small number of monthly instalments of $5 or more.



WHAT OWNERS SAY

"Comprehensive and authoritative. Nothing has been left undone to make it thorough and complete."

Chief Justice Hughes

"With so much more knowledge in the world today than any one mind can possibly master, modern education has become primarily a matter of opening doors, and no one work contains so many passageways into undreamt-of fields of science, art and history, as does the new Encyclopaedia Britannica . . ."

Mrs. Franklin D. Roosevelt

"It is the ideal Encyclopaedia for a home with children—indeed, for any home."

Willis A. Sutton
Recent Pres. Nat'l Education Ass'n

56-page Free Booklet

Fill out the corner coupon, mail it and receive by return mail a large 56-page booklet free, rich with color plates, maps and sample pages. It contains a full description of the Britannica and how you can make it your most useful possession. Send for free booklet today. No obligation.

SEND FOR FREE BOOKLET TODAY

ENCYCLOPAEDIA BRITANNICA, Inc.
342 Madison Avenue, New York City

Please send me, by return mail, without obligation, your 56-page illustrated booklet with color plates and maps from the *New* Britannica, together with low price offer, etc.

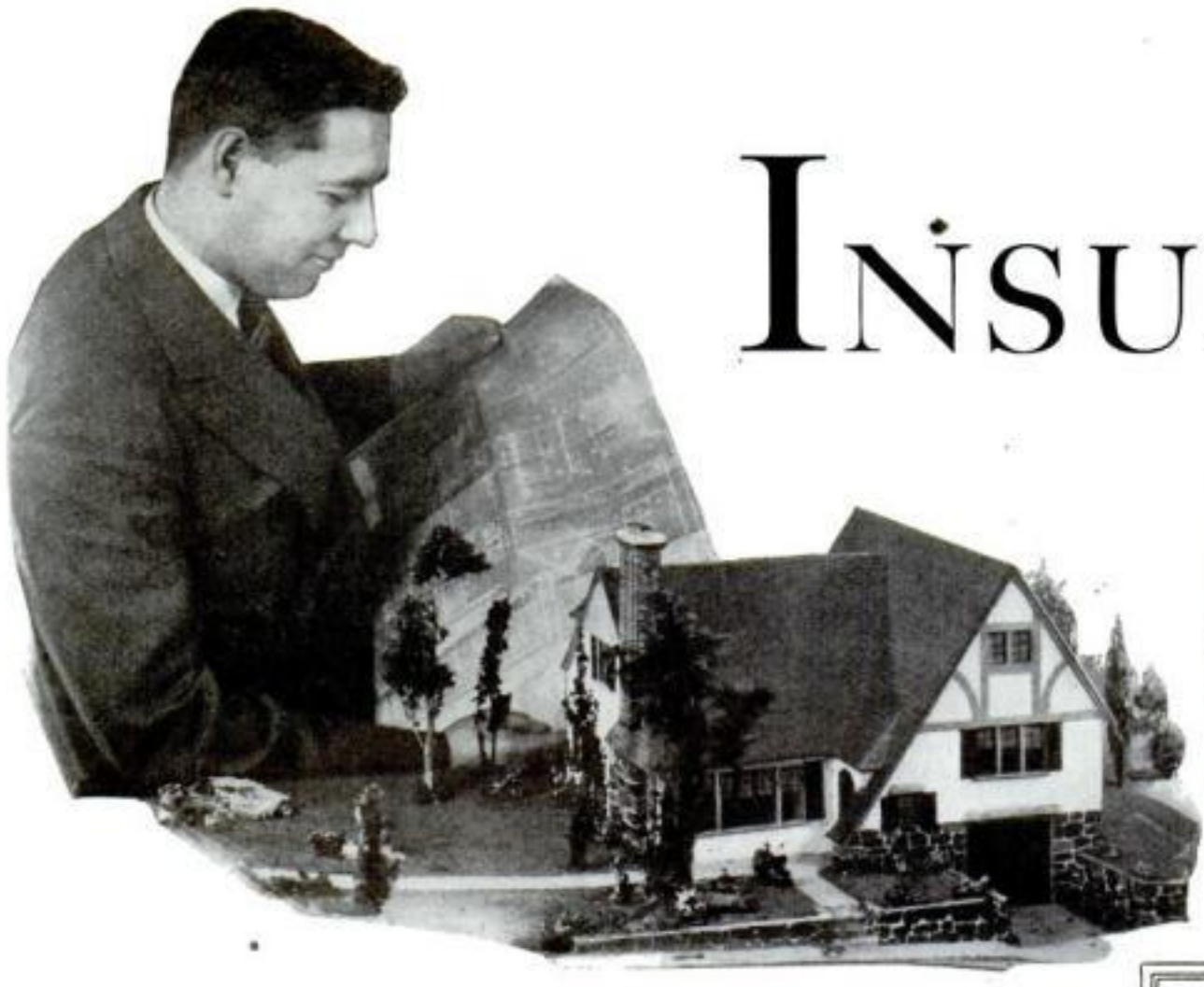
1 P. S. M.—D2

Name.....

Address.....

City.....*State*.....

Take Your Choice of Materials... ...*but* INSULATE



By F. G. PRYOR
Secretary, Popular Science Institute

SINCE the cost of insulating a house usually comes to about two percent of the entire cost of building, and since it means a reduction in heating cost of about thirty percent or thereabouts, builders and buyers of homes are not just following a fad in demanding insulation.

While economy is one of the chief advantages of insulating a house, it also brings about a degree of comfort that alone would justify its use. Changes in outside temperature are scarcely felt in the insulated house, drafts are eliminated, summer heat is much less oppressive, and there is a deadening of noise.

This use of insulation in house construction is a development of the last fifteen or twenty years. Formerly one's choice of insulating materials was rather limited, while workmen who knew how to apply it properly were hard to find.

The physical properties and structural features of these insulating materials differ, but there is one thing that all types have in common. They all have within them a large number of very small cells that form minute dead air spaces which make them effective in stopping the flow of heat through the roof and walls of a house wherein they are applied. Another thing about all good insulators is that they must discourage vermin and, too, they must be resistant to fire and moisture. Some insulators possess these features naturally but most are put through special processes that make them satisfactory as regards these points.

MATERIALS may be classified roughly as falling into four groups:

1. Boards
2. Blankets or Quiltings
3. Felts
4. Fills

Those classed as boards are in sheet form and are more or less rigid. They consist of various combined materials that can be readily sawed and nailed. Because of the ease in handling a material of this type, and because it is sometimes of use in adding strength to a structure, board type insulation is very widely used. Boards are a good choice when the insulation is to do duty both as a heat resistant and a wall board or plaster base.

Insulation in blanket or quilt form is more or less flexible, as the terms imply. The matted fibres are generally placed between sheets of paper, usually being sewn in both crosswise and lengthwise. They are applied with stripping. Blankets and quiltings are preferred by many architects for roofs.

Felts are semi-flexible and can be bent without breaking. They consist of built-up thicknesses of fibrous material, stiff enough to be contained by either physical pressure or an adhesive binder, or both. A fill is a loose form of insulation that can be poured or packed between retaining partitions while wet or dry.

In choosing an insulating material the points to consider are whether or not it is applicable to the kind of structure being put up, what the proper thickness would cost in that particular locality, and how much the labor costs would amount to.

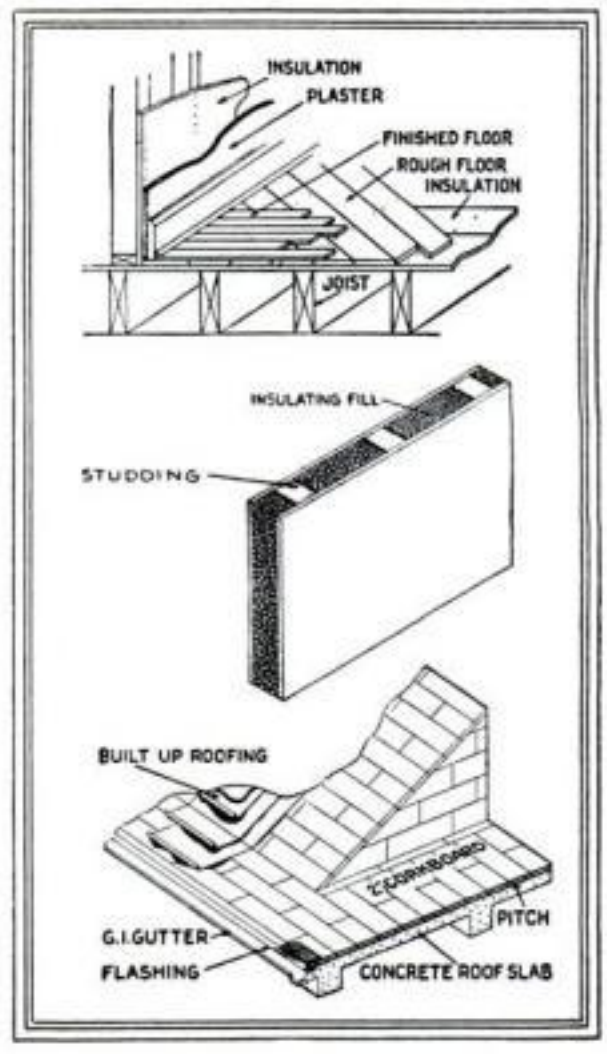


Diagram shows how insulation should be used in wall, floor, and roof for best results

For those readers who wish to go into this matter of insulation more thoroughly, a booklet has been prepared which goes into detail regarding the various materials, their relative effectiveness, method of applying, etc. Quite an amount of helpful information will be found in this little 24-page booklet entitled "Insulation in Building Construction." To secure it, send 25 cents to Popular Science Institute, 381 Fourth Avenue, New York, N. Y.

THE SHOCK-ABSORBING BLADE

Smiling millions told their friends

MEN by the million tried the shock-absorbing Probak—pronounced it a revelation—told their friends. Shock-absorber construction and automatic machine manufacture make Probak a better blade. Try Probak on ourmoney-backguarantee.Get far finer shaves or your dealer will refund the full purchase price—$1 for 10, 50c for 5.

For Gillette and Probak Razors

PROBAK BLADES

If you're Up In The Air about Cool Shaving

THE 2 INGRAM BARBERS • TERRY TUBE OR JERRY JAR

ZOOM into this one! Ingram's has the altitude record for cool shaving all locked up in the hangar!

What a shaving cream! What a cooling, soothing, chin-charming cream! It leaves your cheek as cool as a polar excursion and takes the fight out of the meanest whiskers that ever dulled and dented a blade! For Ingram's is

cool! Cooler!! COOLEST!!!

Select the package—tube or jar—that suits you best! The famous blue jar's the most economical shaving cream container ever made. The tube may be more convenient.

But—jar or tube—both are full of the same whisker-wilting cream! And there's not a smart or burn or sting in a dozen of either.

Ingram's is cool because we set out to make it cool. Coolness is part and parcel of its wonderful formula.

In every jar and every tube we put the three special ingredients that make Ingram's a three-in-one blessing to the cheeks of man—as good as a shaving cream, a lotion and a tonic combined—and much more economical!

There's no other shaving preparation so cool as Ingram's. You've never bought another cream that so absolutely frees you from those mean little annoyances—those scrapes and nicks—that turn shaving into a burden.

Try ten cool shaves at our expense. We're willing to take the chance that they'll bring you back for more! Just send in the coupon below.

INGRAM'S *Shaving Cream*

IN TUBES OR JARS!

10 COOL SHAVES—FREE

BRISTOL-MYERS CO., DEPT. H-111
110 Washington St.,
New York, N. Y.

I'd like to try ten cool Ingram shaves.

*Name*_____

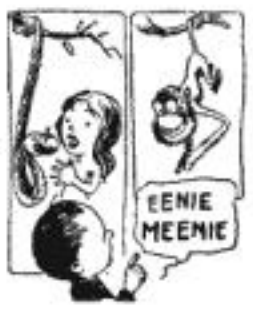
*Street*_____

*City*_____ *State*_____

Our Readers Say

If It's Mystery You Want, Why Not Evolution?

L. R. C. of Los Angeles should get broad-minded enough to see that turn about is fair play. He states that the only people who believe in the articles by Dr. W. K. Gregory are those that "love mystery and superstition." Isn't it possible that he believes what he does because of mystery? Also, what right has he to say that those who agree with Dr. Gregory know nothing at all? He is evidently one who believes in the mystery of a supernatural creator that someone imagined and passed on. Anyone that believes in a theory that has no proof except that someone said so must be the one that knows nothing. I have no objections against your magazine in any way. Variety is the spice of life and you certainly offer it. Hoping you will keep up the good work.—R.J.M., Centralia, Wash.



Old As They Are, Gas Ranges Are Still Interesting

WHY do you still print radio articles? Radio is no longer a novelty. Sets, good sets, too, are so cheap that nobody builds his own. What possible good purpose, then, can your articles on the subject serve? A radio receiver is now just an ordinary piece of household equipment, and articles on radio have no more place in a scientific magazine than articles on gas ranges, electric light fixtures, and clothes wringers.—F.C.L., Rantoul, Ill.

Weighing the Earth Is Easy, If You Only Know How

IN LOOKING over "Our Readers Say" department I saw the question by W. M. H. B., Bellingham, Wash., concerning the weighing of the earth. The way I look at it what he asks is possible if he could get the foothold in space. But why not get The Pocket Guide to Science, and find a real way to weigh the earth? Why not run a department in the magazine concerning simpler chemistry and physics as they are taught in high school so we could at least refresh our memories?—R.B.D., Sheffield, Pa.

Hats and Ties Are Just So Much Sponge Cake

I WAS particularly interested in the letter of H.B.H. of Philadelphia with reference to dress reform. It is high time men adopted a more sensible dress. The things we wear at present are neither good to look at nor healthy. The style suggested by H. B. H. would be fine especially if one leaves off the tie. Why wear a tie anyway? They are no use. The hat might easily be done away with, too. What were we given hair for? It would be interesting if a popular vote could be taken on this important subject.—W.A.L., Hardisty, Can.

Evolution Got Him and He Wants More Facts

IT WAS the announcement that POPULAR SCIENCE MONTHLY would publish articles on evolution that has started me to reading the magazine. I look upon evolution as the greatest problem in the world today, and one that has more to do with man's theistic and atheistic views than any other and hence the necessity for an unbiased and scientific consideration—viewing the problem not from one side simply, but from both sides. Candidly, I have been somewhat disappointed in the treatment of the subject by the learned doctor, as I don't think he voices the popular trend of modernists; but his sketches are interesting.—S.M.K., Springfield, Colo.

Thanks for the Offer, but What'll We Use for Money?

AT PRESENT one can't sell anything for the cost of production. I have rooms full of stuff now that cannot be sold for what it cost, and yet expenses go right on. Those that are perishable are sold for a song. I sold potatoes, that cost me seventy-five cents to produce, at forty-two cents a bushel, full U. S. No. 1's! And I'll take a bet that you consumers up there are paying anywhere from $2.00 to $2.50 a bushel for the same product. Cotton, grain, fruits, vegetables, and everything else are below production cost to the man producing them, and yet the consumer is getting no benefit from it. Worlds of foodstuffs, thousands out of a job and starving in the midst of plenty! I shall be glad to send you a crate of peaches gratis if you care to pay the transportation charges.—W.M.R., Bishopville, N. C.

Here's One Vote Against Any Radical Change

YOU may be sure that I shall continue to buy your magazine from the newsstand and I shall always be a steady reader. I now have eleven years' copies on file, and am constantly referring to them. Please do not make any radical changes in the magazine—it is ideal for general reading as it is and changes would lose me an old friend.—H.D.A., Centralia, Wash.

He Simply Boils Over at Attacks on Carpentry

HAVE just finished reading "Our Readers Say" and am moved to write you my gratitude for the wonderful magazine you continue to publish. I am glad that none of the seemingly dissatisfied readers are able to change your opinion as to what the readers of your publication want. As for those who object to carpentry, their criticism simply makes me boil over and I cannot find words in which to express myself. But I should like to call their attention to the fact that carpentry is one of the oldest and most useful of the arts. I am thankful that I can read your magazine, and every number issued during the past few years is stored in my attic, for they have earned their keep through the steps I've been saved by the knowledge gained from them.—L.S.Y., Berkeley, Calif.

Don't Use Old Parts in Your Rebuilt Racer

I NOTICED an article in a recent issue of POPULAR SCIENCE MONTHLY written by P.H.L. concerning amazing revelations to come in auto racing by using model T Fords. As I have been at the game for five years and have held seven track records, I should like to advise P.H.L. that a race car is a specialized machine in which second-hand parts are not tolerated, especially spindle arms, axles, etc., in fact anything pertaining to the wheels. P.H.L. mentions eighty-five miles per hour, and as eighty-five miles an hour is entirely too fast to lose a wheel or anything else, I ask him to reconsider, and to use only new parts.—S.A.G., Los Angeles, Calif.

They're Hoeing a Tough Row Out There in Australia

RECENTLY I began reading POPULAR SCIENCE MONTHLY and would like to express my appreciation of the value which I derive therefrom. The section devoted to letters from your readers was quite surprising to me when the extreme candor permitted was taken into consideration. As you probably know, we in Australia are hoeing a pretty tough row at present, and articles such as those by Michel Mok are highly informative. I should like to suggest in answer to your query, "What will success in Russia do to us in America?", that such success will be fraught with grave consequences to America, and not only to you, but to every country in the world. I think it will literally prove to be a rod for your own back, as well as ours.—L.E.M., Adelaide, Australia.

Just a Little Problem but It's Got Him Woozy

I'VE got a little problem that I thought of all by myself but to which I cannot find an answer. Fools ask questions that wise men can't answer, and maybe that's my trouble, but anyway it's like this: There is an old saying that no chain is stronger than its weakest link. Therefore the chain, under strain, would part at its weakest point. If a chain could be made absolutely uniform throughout, I argue that no matter how small the chain may be, it would never part regardless of what strain was put on it, because if it parted at one place that would be its weakest point,

but as there is no weakest point it could not break. Where am I wrong for of course I assume I'm wrong somewhere?—B.C., Gloversville, N. Y.

Does Slowing Down the Earth Shorten Human Life?

In a recent issue of Popular Science Monthly, I read a letter by W.F.G., Corona, L. I. Since reading it I have evolved a simple theory of my own that leads me to agree with him. I believe that the earth is rotating with less speed than it did hundreds and thousands of years ago. As Einstein says, a clock, when in motion, moves more slowly than when at rest, so if a person were to travel to a distant planet at tremendous speed and return he would be no older at the end of his trip than when he started. So the people of today do not live as long as our forefathers because the earth rotates more slowly. For example a person who is ill is ordered to rest so his organs may work more rapidly and thus get time to repair his body. Those who do no work, either mentally or physically, live to a ripe old age. This theory may sound foolish but I should like to hear what your readers think about it so they can set me right if I'm off on the wrong track.—J.A.G., Scranton, Pa.

As Long As We Publish He's Going to Have His Copy

I think if some of those knockers who are always kicking about this and that in the Popular Science Monthly were cut off so they would not be able to see an issue for say about six months, you would find they'd have a change of heart. In fact I believe the first thing they would do would be to write in for the back numbers. I have taken Popular Science Monthly, as near as I can figure, for about six years, and I still haven't found anything in it to find fault with. It stands above all other magazines. As long as there is a Popular Science Monthly printed I'll take it, and I believe I've expressed the opinion of the majority of readers.—S.J.C., Port Huron, Mich.

What Can You Tell Him About That Table Walking?

Have just read your article on astrology and would like to read one on what you think of table walking. I have friends who try this now and then but I think it's a fake. I should be glad to hear what others have to say about this alleged spiritualism.—L.D., Houston, Texas.

Any Minute, Now, the Angels May Get Us

Of all the magazines in existence, and I have read and sold many, Popular Science Monthly is for me positively the best. The articles about evolution by Dr. Gregory are very understandable. The answers to the questions make everything perfectly clear. I suppose that with your magazine there are places at which it could be improved, but as I am thoroughly satisfied I won't attempt to point them out to you. For me Popular Science Monthly is the perfect magazine and if it gets any better the angels will grab it and it will be just too bad for us poor fellows down here.—Mrs.A.H., Indianapolis.

Here's Another Booster for That Phonetic Spelling

I agree with P.L., of Newton, Kan., and Teddy Roosevelt that words should be spelled exactly as they are pronounced. What in——is the silly idea of spelling Philadelphia with a Ph instead of an F? Why is C often pronounced like S and why are C and K sounded alike? Why not give one of these letters a different sound or drop it from the alphabet? Why do we spell it "psychology" instead of "sycology?" Why silent letters and double letters? If a letter is neither heard nor pronounced, leave the——thing out. The dictionary should be simplified.—A. V., New York.

This Should Hold That "Dumb Reporter" for a few Minutes

If your reporter is so dumb that he thinks he is in Wilmette, Ill., when he is in Highland Park, Ill., you had better get rid of him, because more mistakes like that won't do. The observatory mentioned in your article is not at Wilmette, but at Elm Place School, Highland Park, Ill.—T.O.J., Randolph, Va.

Come On, Auto Experts, and Shorten His Wheelbase

I agree with P.H.L., of Ohio. I make a motion that you print an article about lowering the body of a model T Ford. I would like to know if you could shorten the wheelbase of a Ford. Will some kind reader please tell me if it is possible? I believe Ye olde Ford would look mighty cute if it were shortened and had a racer body on it. It would look prettier if it were painted green with pink polka dots. Maybe Gus could tell us something about it. (I mean the Ford; not the paint.) While you are at it, I would like to know how to make the radiator narrower so that the Ford would look streamlined.—H.L.H., Galveston, Texas.

Astrology Not to Be Banned in a Wholesale Manner

I have just read your article by Jesse F. Gelders, "Famous Scientists Tell Why Astrology is a Fake." Mr. Gelders apparently is an able writer, but I cannot say that he is an intelligent writer, because he did not acquaint himself with his subject first. He made too many statements that lay him open to the severest ridicule from simon-pure astrologers. In the first place Mr. Gelders asked "Famous Scientists" to tell him the story. Astronomers! Astrology, as Mr. Gelders admitted, is the parent science from which astronomy evolved, but now the two have nothing in common. Mr. Gelders is correct mainly in his tirade against the radio artists. He is correct to a great degree in his denunciation of millions of so-called horoscopes that are being palmed off on a gullible public for a dollar or two. But to include the science of astrology, from A to Z, in that denunciation because of the fakes who go "on the air" is doing a great injustice to hundreds of honest, educated, capable, scientific men and women.—M.E.O'N., San Juan, Texas.

Opinions May Differ but He Likes His Magazine

Popular Science Monthly is, I believe, without question the best publication of its class and I have always found the greatest pleasure in reading and studying the various items published in it. It has been of interest to me to note the various opinions expressed in "Our Readers Say," some offering compliments and some complaints. Of course we all have different likes and dislikes, but in my opinion Popular Science Monthly is in a class by itself and nothing can be compared with it. I am a booster for it and always shall be. With best wishes for your continued success.—L.A.J., Portland, Ore.

Almost Everything Came From the Same Place

Are we using your blueprints? Sure we are. And we have pictures of a tea wagon and a Spanish galleon ship model to prove it. Each was made from your plans with the aid of machinery advertised in your magazine. The pictures were taken with the help of recent articles you published on photo taking and taken with a camera purchased with money won in one of your "What's Wrong?" contests. How's that?—F.H.T., Stratford, Can.

Our Story of Life Does Not in the Least Disturb Him

Having read with interest your articles on the "Story of Life," and feeling sure there will be a diversity of opinion, I wish to contribute my part to the discussion. It seems to me that the subject is greatly misunderstood, but I am confident your set of articles will go far toward clearing up this misunderstanding. No hard feelings for the theory or the scientists who advance it prevail in my mind as I see in the case with some people. It is merely the Creator's method of working and was not meant to excite the disturbance with which it has been met. I write these words to D.J.S. who reveals an unbecoming attitude toward scientists and their work, and also to L.R.C., who says, "A man must have a lot of brains to tell people that his father was a monkey." Such a man must have a lot of brains to lay the problem before the world in such a way as to have it unfold the triumph of creation and leave not a doubt as to the work of the Creator.—G.W., Philadelphia, Pa.

What Do You Think: Machine or Men on Cover?

I don't like your covers. Why not have pictures of men who have contributed their life's work to science on your covers? I think if you would put pictures of Edison, Ford, Wright brothers, etc., on your covers the readers of Popular Science Monthly would appreciate it very much as many people would like to have good pictures of these men. I for one would surely like it.—A.R., Watertown, Wis.

One Little Pot Shot at Our Famous Scientists

Your "famous scientists" evidently did not consult any of the real astrologers, but did consult some of the real fakes. I have had the privilege of knowing that astrology, as applied by experts, is an exact science. I would suggest that you consult some expert and maybe you will get a different light on the subject. I will not believe a thing in your magazine about astrology until you do consult some such expert. I like your magazine very much but I cannot understand why you publish an article that is absolutely full of untruths and proves nothing.—H.E.DeL., Lake Placid Club, Essex County, N. Y.

An even greater opportunity for boys

AWARDS

Four University Scholarships as International Awards

ENROLL TODAY

FISHER BODY CR

Dealers in General Motors Cars

The Fisher Body Craftsman's Guild has been organized under the sponsorship of the Fisher Body Corporation, to stimulate and develop craftsmanship among boys between the ages of twelve and nineteen years inclusive.

The Guild welcomes you to membership entirely without cost and invites you to take part in the second friendly competition where skillful handiwork is the one and only thing that counts.

This opportunity is open to every boy within the age limits mentioned, in the United States and Canada.

The test of ability this time will be the same as in the recent big competition which enabled boys to win 984 valuable awards. Every boy who enters will construct a miniature model Napoleonic coach, from detailed plans and instructions furnished by the Guild. The judges, both State and National, will be men of the highest standing in the knowledge of fine craftsmanship. At their head, as Honorary President of the Guild, is Daniel Carter Beard, America's beloved National Boy Scout Commissioner.

Perhaps you know some of the 104 State winners who attended the recent convention at Detroit. They'll tell you what honors and friendships the Guild brought to them. And as for the four scholarship winners, pictured at the right—! Well, just remember that there are four more of those $5,000 university scholarships waiting for *you*. So join the Fisher Body Craftsman's Guild right away and get an early start toward success.

Enroll NOW with any General Motors Car Dealer

Just go to any dealer in General Motors cars and say you want to join the Fisher Body Craftsman's Guild. Dealers in Cadillac-La Salle, Buick, Oldsmobile, Oakland-Pontiac and Chevrolet are all General Motors car dealers. There is one in your community.

As soon as your enrollment is registered, you will receive from Guild headquarters your membership card and official Guild button, and a complete manual containing scale drawings of the model coach, instructions for building it, pictures of the coach in full color, and all other information pertaining to the Guild.

If you entered the first Guild competition, try again! (Memberships must be renewed.) If you missed the first chance, by all means get in this time. Enroll *now*.

FISHER BODY CRAFTSMAN'S GUILD

Sponsored by FISHER BODY CORPORATION

DETROIT, MICHIGAN *Division of General Motors*

H O N O R A R Y B · O · A

THOMAS S. BAKER
President
Carnegie Institute
of Technology

P. R. KOLBE
President
Polytechnic Institute
of Brooklyn

S. W. STRATTON
Chairman of the Board
Massachusetts Inst.
of Technology

R. L. SACKETT
Dean of Engineering
Pennsylvania
State College

Rev. T. A. STEINER,
C.S.C.
Dean
College of Engineering
Univ. of Notre Dame

M. L. BRITTAIN
President
Georgia Institute
of Technology

W. A. FISHER
President
Fisher Body Corp.
President of the Guild

throughout the United States and Canada

valued at $75,000

116 Trips to Detroit and 1120 Gold Awards

IN THE

AFTSMAN'S GUILD

Will Welcome You to Enrollment

EACH OF THESE BOYS EARNED A $5,000 SCHOLARSHIP

R. S. DOERR (S)
267 Oneida Street
Battle Creek, Michigan

ALBERT FISCHER (S)
541 Bluff Street
Waukegan, Illinois

This is the model Napoleonic coach which thousands of boys built in the first competition of the Fisher Body Craftsman's Guild. The same model will be the basis of the new competition announced herewith.

D. C. BURNHAM (J)
353 Chauncey Street
West Lafayette, Ind.

H. JENNINGS (J)
1235 South Rose Street
Denver, Colorado

INTERNATIONAL AWARDS

Four University Scholarships of four years each

Two of these Scholarships go to Juniors (12 to 15 years inclusive) and two go to Seniors (16 to 19 years inclusive).

Ten Awards for Seniors and Ten Awards for Juniors in Every State and Canadian Guild District as follows:

1st State or District Award	Trip to Detroit and $100 in gold
2nd State or District Award	$100 in gold
1st State or District Woodcraft	$ 25 in gold
2nd State or District Woodcraft	$ 15 in gold
1st State or District Metalcraft	$ 25 in gold
2nd State or District Metalcraft	$ 15 in gold
1st State or District Trimcraft	$ 25 in gold
2nd State or District Trimcraft	$ 15 in gold
1st State or District Paintcraft	$ 25 in gold
2nd State or District Paintcraft	$ 15 in gold

Every Guild member who submits a completed coach on or before midnight July 1, 1932, will receive the Guild Certificate of Craftsmanship.

R D O F J U D G E S.

D. C. BEARD
Nat. Boy Scout Comm.
Honorary President
of the Guild

D. S. KIMBALL
Dean
College of Engineering
Cornell University

M. E. COOLEY, Eng. D.
Dean Emeritus, College
of Engineering and
Architecture
University of Michigan

E. A. HITCHCOCK
Dean
College of Engineering
Ohio State University

GEO. J. DAVIS, Jr.
Dean
College of Engineering
University of Alabama

R. A. MILLIKAN
Chrmn. Exec. Council
President, California
Institute of Technology

W. F. DURAND
Professor Emeritus
Mech. Engineering
Stanford University

New in method style and mode

MASONITE *Cushioned* FLOORING

OF TEMPERED PRESDWOOD

First in this remarkable Masonite family came Structural Insulation and QuartRboard, next Presdwood, then Tempered Presdwood . . . and now *Masonite Cushioned Flooring* —both a flooring and a floor covering, and new and modern in method, style and mode.

As its name suggests, it has an in-built shock absorber, which eliminates much of the fatigue and discomfort from walking. It is of three-ply construction—outer layers of *durable, wear-resisting* Tempered Presdwood, impervious to moisture and specially toughened by a process similar to that used in tempering steel; an inner layer, or cushion, of QuartRboard to provide resiliency, insulation, sound absorption.

Masonite Cushioned Flooring is *beautiful*, with endless combinations of design and pattern. It is *economical*, in first cost, in application, in long life, in elimination of floor covering.

Architects, contractors, home and building owners appreciate its practical features, its utility either in new construction or modernizing. Note its distinctive points listed on this page. Also send coupon—today—for folder.

Ten points of superiority

1. Appearance—Smooth, beautiful, grainless squares and borders.
2. Durability—Built to withstand wear; Tempered Presdwood surfaces assure long service.
3. Style—Something entirely new.
4. Resiliency—QuartRboard cushion makes walking easy and restful.
5. Grainless—An all-wood flooring, yet free from splinters.
6. Perfect Joints Interlocked—Tongue-and-groove construction provide smooth, snug fit.
7. Easily Laid—Can be either nailed or cemented.
8. Variety of Designs—No end to patterns—6, 9, 12-inch squares; borders 3, 6, 12 inches wide; 47 inches long.
9. Reversible Squares—Dark on one side; light on other.
10. Flooring and Floor Covering—All in a single unit.

Masonite *Cushioned* **FLOORING**

STRUCTURAL INSULATION . INSULATING LATH
PRESDWOOD : QUARTRBOARD

MASONITE CORPORATION, Dept. D-11
111 W. Washington Street, Chicago, Ill.

Please send your free illustrated folder that describes Masonite Cushioned Flooring.

*Name*_____

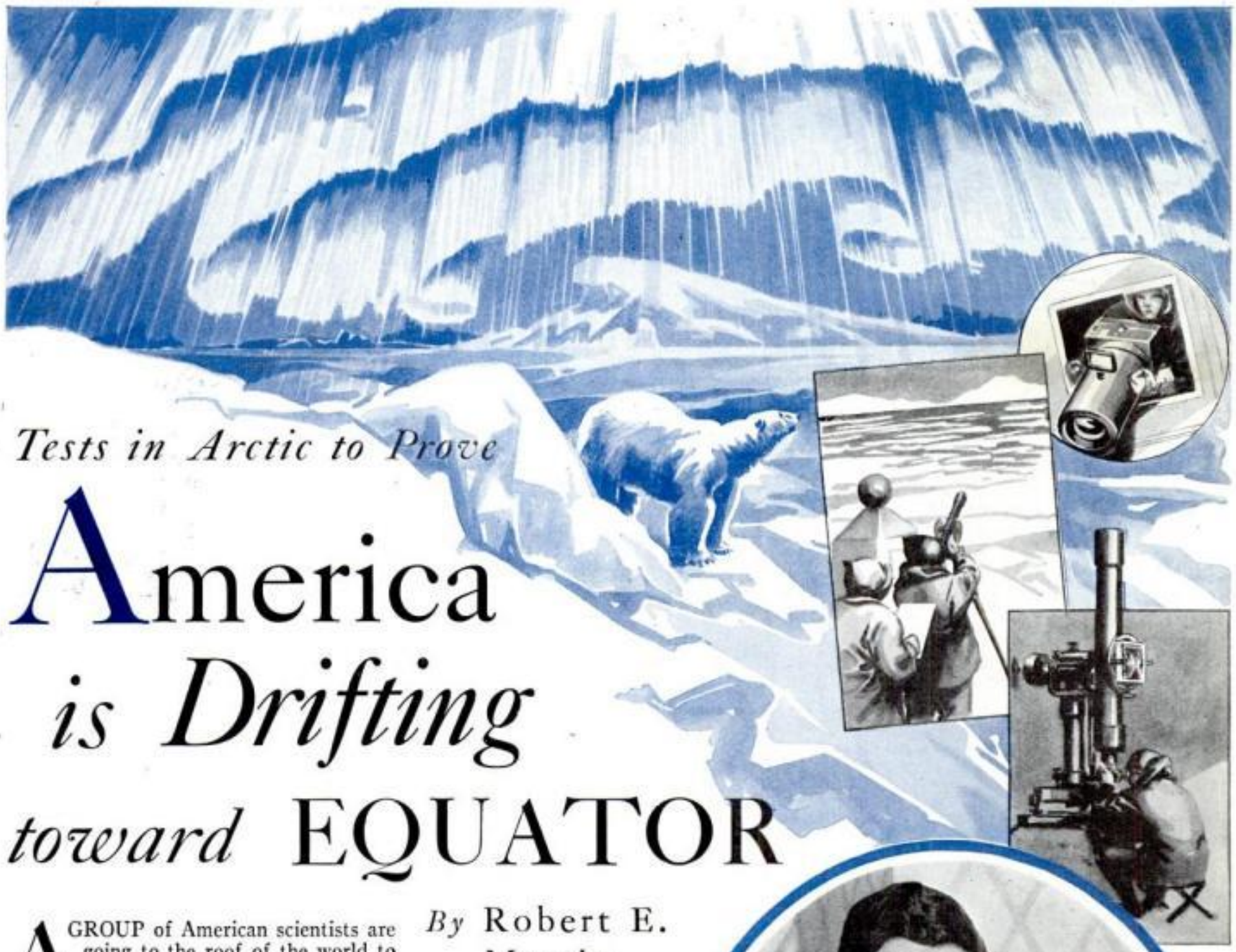
*Street*_____

*City*_____ *State*_____

POPULAR SCIENCE
MONTHLY

November 1931 Vol. 119, No. 5

RAYMOND J. BROWN, *Editor*



Tests in Arctic to Prove

America *is Drifting toward* EQUATOR

By Robert E. Martin

A GROUP of American scientists are going to the roof of the world to find out if the dry land on which we live is "anchored" to the central mass of the earth or floating on it. During a two-year stay in the Arctic, they will test the amazing theory that North America and the other continents are continually floating slowly about on a sea of molten rock like great rafts on a quiet ocean.

Led by Capt. Flavel M. Williams, of the U. S. Naval Reserve, the eighteen members of the expedition plan to sail from New York early next spring. Dr. H. B. Maris, of the Naval Research Laboratory, Washington, D. C., will direct the labors of the corps of scientists, with the Carnegie Institution, the U. S. Naval Hydrographic Office, and the U. S. Weather Bureau coöperating in the tests to be made.

Just west of the northern tip of Greenland, their Diesel-engined ice-breaker will "freeze in" and form the base of operations not far from long-deserted Fort Conger, where the Greely Expedition, first scientific exploration of the Arctic,

At top, aerial camera and telescopes with which pictures and accurate measurements will be made in Arctic to test theory that America is floating south. Above, observation balloons for use in getting weather data

Capt. Williams, U. S. Naval Reserve, who leads trip

Dr. H. B. Maris with his zenith telescope, most accurate scientific instrument ever to be taken into the Arctic. It will test theory that Greenland is floating steadily toward American shore

encamped just fifty years ago. Here on Grant Land, the spot where the aurora borealis is believed to originate, they will begin their work.

The Arctic is chosen for the tests, Capt. Williams told me at his New York headquarters, because the clear atmosphere permits the accurate astronomical observations necessary for the exact location of points on the earth. With such observations as a final check, he hopes within the next two years to detect and time the movement of Greenland and thus prove the strange theory of drifting continents, first advanced by the late Dr. Alfred Wegener, famous geologist of the University of Gratz, Austria.

Dr. Wegener maintained that all the continents of the earth once formed one great land mass. In the remote past this land mass split up, forming the present continents, which, he held, are still moving, with North America drifting slowly toward the equator.

But imagine yourself holding a stop watch on something moving two miles in a million years!

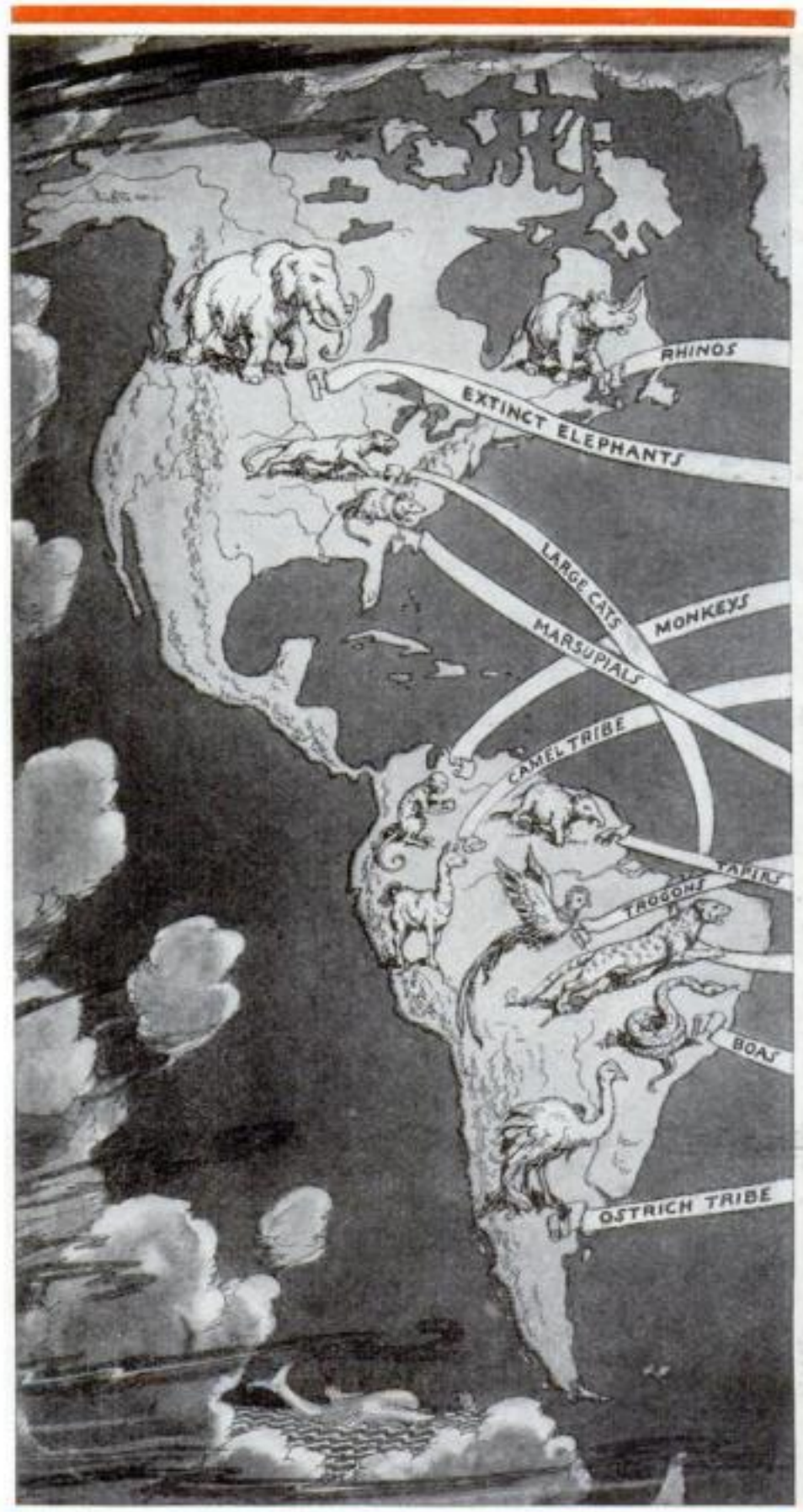
THAT is the rate at which Dr. Wegener estimated some of the larger continents are drifting. The "speed king," he declared, is Greenland, believed to be crawling westward at the rate of six feet a year. The cleavage between Greenland and Europe was the most recent breaking away, according to his calculations, and occurred within the last 100,000 years. Ireland and Newfoundland, he believed, once were one, separating between two and four million years ago, while South America broke away from Africa between twenty and forty million years ago.

The "stop watch" to be used by the Williams Expedition, I was told, will be an elaborate collection of scientific instruments, including a $60,000 "astronomical transit," special aerial cameras, and two airplanes. Dr. Maris has perfected astronomical instruments so accurate that it would be possible for him to tell which side of a room he is standing on by sighting at the stars!

The first step in the work of testing Dr. Wegener's theory, Captain Williams explained, will be to sink to bedrock two concrete markers, shaped like monuments six or eight feet high. They will be placed exactly eighteen miles apart, one on the Greenland shore and one in Grant Land. Then a camera-carrying monoplane will climb until its super-sensitive altimeter shows it is exactly 16,800 feet above the tiny markers. At this point, once a month during the expedition's two-year stay, an aerial photograph will be made.

Experts with delicate instruments will then compare the position of the markers in succeeding photographs, detecting any changes in the distance that separates them. Because Greenland is eternally covered with glistening ice and snow and Grant Land has brown barren rocks exposed in summer, the Greenland marker will be painted orange and the Grant Land one white, so they will be clearly visible in the pictures.

But suppose Greenland and Grant Land are moving at exactly the same speed? Then the markers would be like two



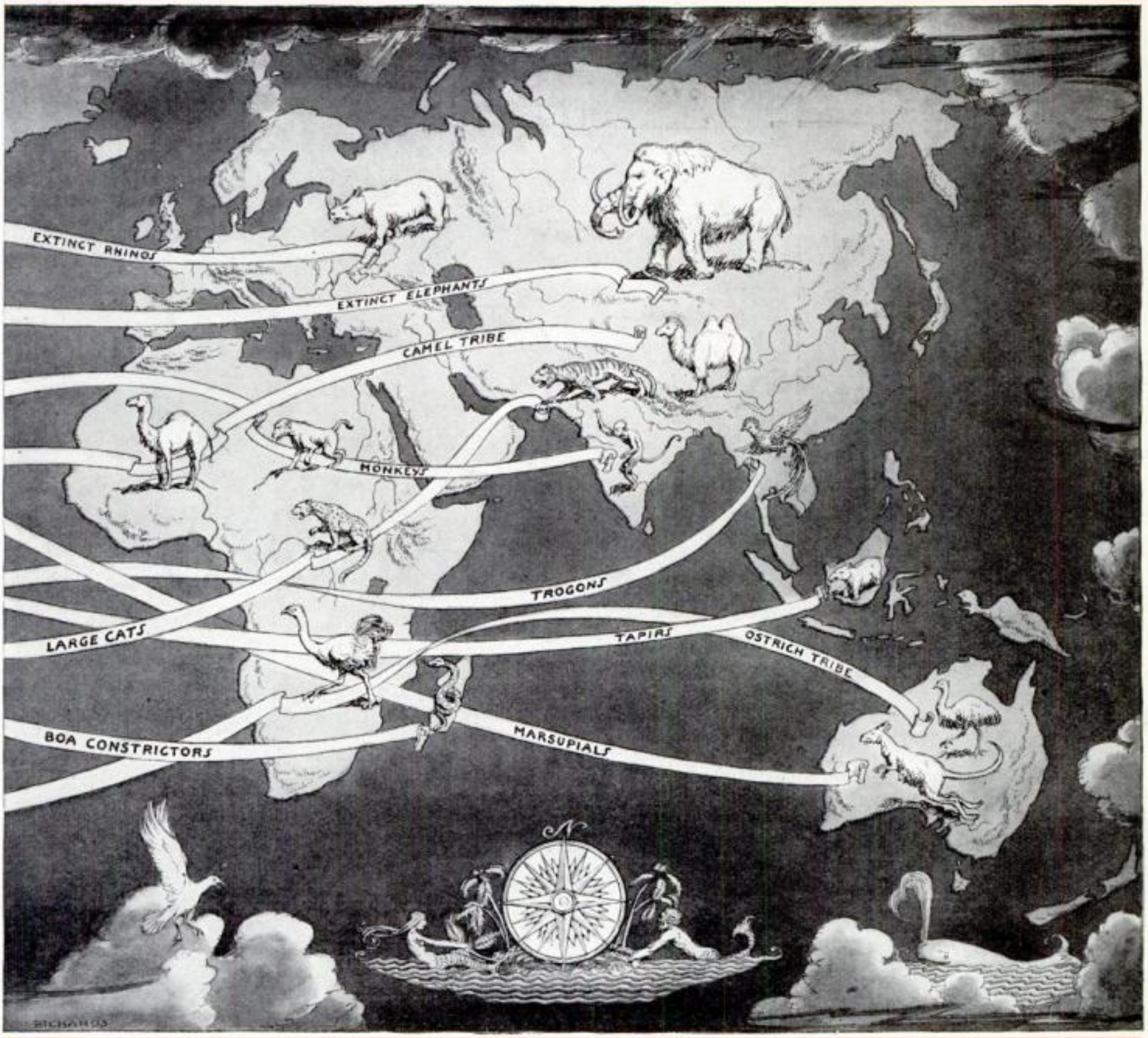
IDENTICAL OR RELATED species of

people on a train, sitting one behind the other, both moving but remaining the same distance apart. While evidence leads the scientists to believe that the two land areas are not moving at the same rate, Captain Williams told me, they are taking no chances.

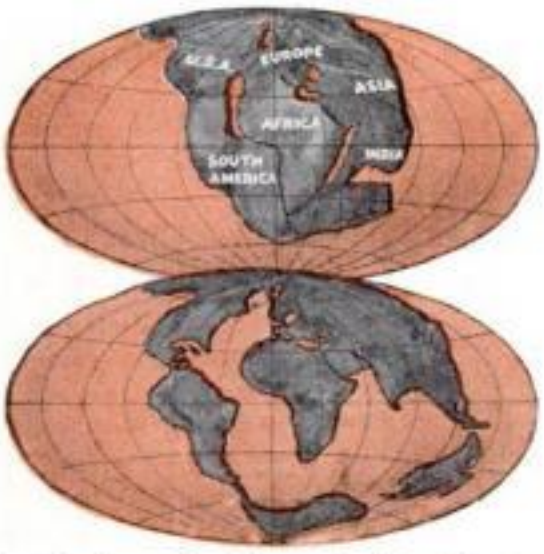
Dr. Maris will constantly check the position of the markers by observations with his special sextant and telescope, using the Pole Star, which changes its position least in the northern sky, as the heavenly body on which to line up his measurements. By using this star and the two markers as three points of a triangle, he will be able to check on any movement of the concrete pillars.

FROM their base far north of the last Eskimo village, the expedition will also map 100,000 square miles of the Arctic with their flying cameras; send observation balloons into the stratosphere to study conditions above Greenland, where ninety percent of the storms that sweep over the eastern part of the United States originate; and make special studies of the relationship of the aurora borealis, terrestrial magnetism, and static in radio. From the weather data collected during their two-year stay it is hoped storm predictions can be made from twenty-four to forty-eight hours sooner than now is possible.

Captain Williams, an authority on static electricity and the man



animals are shown on this drawing as evidence that the continents were once joined together



Drawings show jig-saw fit of continents

who first conceived the idea of trailing chains behind gasoline trucks to prevent static charges from igniting the fuel, will carry on the tests in connection with radio, magnetism, and the northern lights. Several aspects of the latter phenomenon will be photographed in color with a special moving picture camera, for later study.

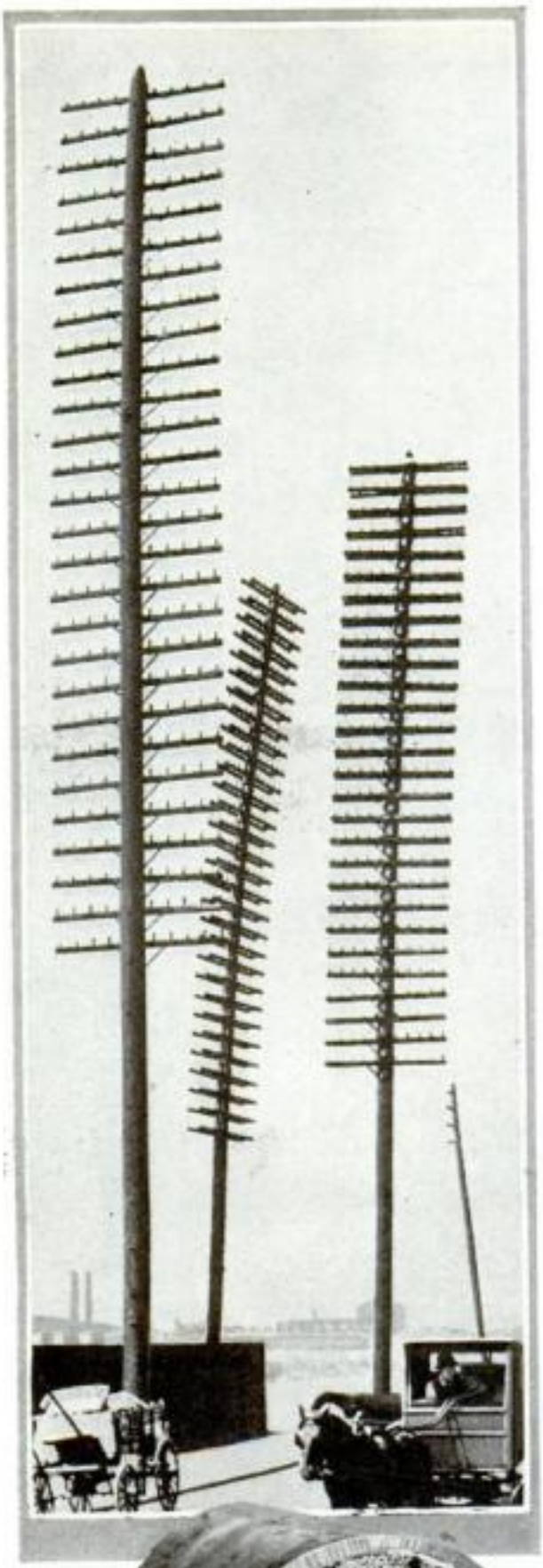
This expedition to the strange, barren "nest of the northern lights" is not the first to seek proof of the continental drift theory in the far north. Four times Dr. Wegener, who originated the theory, went to Greenland for pioneer experiments. On his ill-fated final trip, he disappeared in the Arctic wastes. Last spring, a rescue party found his body beside an upright ski on the great Greenland ice cap. Separated from his companions, he had been overwhelmed by a blizzard and died a martyr to his theory.

That Dr. Wegener was no impractical visionary was demonstrated only a few weeks ago. His radical prediction that Greenland would be found to be depressed in the center, like a gigantic bowl filled with ice, was proved correct. With sensitive instruments, the remaining members of his last expedition timed "echoes" of dynamite blasts set off on top of the ice as they were reflected back from the rocks at the bottom of the cap. They found that at the center of the continent the ice is 8,850 feet thick, while at the margins it is less than 3,000 feet thick.

THE beginning of Dr. Wegener's theory of migrating continents goes back to six or seven years ago. After supper, the scientist was resting in his study, idly staring at a large map of the world hung above his desk. Unconsciously, he began to play a little game with himself, in his imagination sliding the continents around fitting them together like a jig-saw puzzle.

In his mind, he pushed Africa 3,000 miles to the west. The eastern coast of South America fitted into the curve of its western shore; the bulging outline of Brazil filled the Bay of Guinea and the projecting Cape San Roque nestled in the hollow of the Cameroons. He moved Europe across the Atlantic and found the southwest-northeast slant *(Continued on page 142)*

Exploring New York's *REAL* Underworld



Unsightly poles with crossbars, seen above, carried the telephone wires thirty years ago. Now, incased in cables, shown in center, they lie far below the city streets. At right, a maze of cables as seen when the lid is off and workmen get busy on repairs

WHEN the 102-story Empire State Building, tallest office building in the world, was opened for inspection last spring, a foreign engineer visiting New York asked to be shown the furnace rooms and heating plant. To his amazement, he was told that the building contains no such equipment.

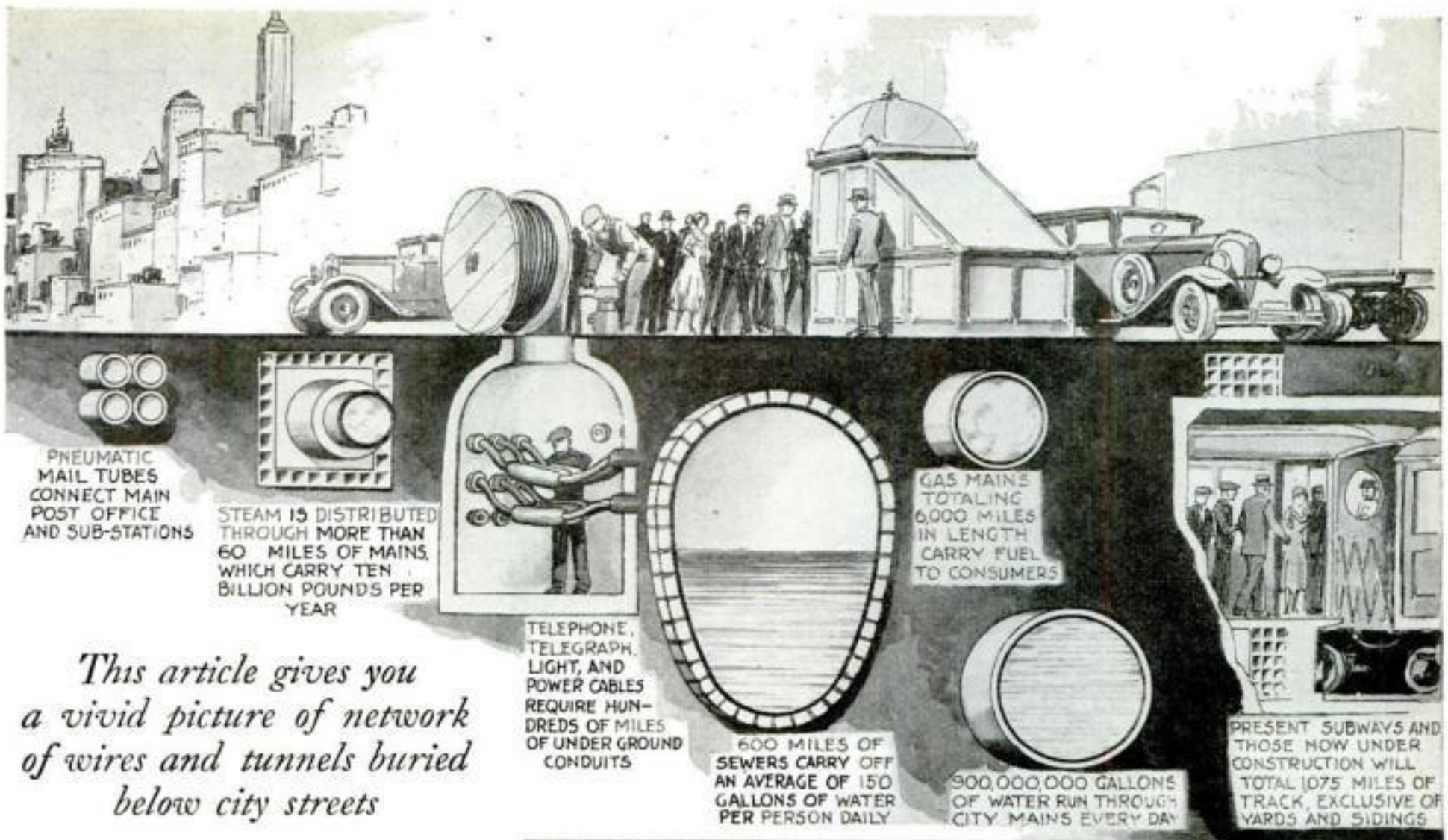
"We buy our steam," said his informant. "It comes into the basement, ready made, through a pipe, just like gas or water. To generate our own steam would require an enormous plant, eating up a huge area of valuable, rentable space. By eliminating the need for flues, furnaces, boilers, and coal bins or oil storage tanks, we have saved hundreds of square feet, to say nothing of actual construction expense. Altogether, by buying steam instead of making it, we have salvaged so much floor space that the yearly income from it will come within about $6,000 of meeting our steam bill."

Supplying steam from central power houses direct to consumers is, next to that of water and gas, the oldest public utility activity in New York, antedating the distribution of electricity by ten years. Over sixty miles of buried mains, carrying an annual output of ten billion pounds of steam, at pressures ranging from 100 to 130 pounds per square inch, are but one example of what lies beneath the skin of Manhattan.

Like the veins, arteries, nerves, and tubes of the human body, the underground pipes, wires, tunnels, conduits, and ducts that keep New York functioning spread in a bewildering maze below the pavements.

This vast subterranean network of vital services, upon which millions depend, is not only a tribute to man's genius but a monument to his lack of foresight. In every great city, our predecessors' lack of vision is being keenly felt. Everywhere narrow streets and inadequate transportation facilities are creating problems unforeseen twenty years ago.

Everywhere engineers are being called upon to perform the seemingly impossible in order to make over our cities and adapt them to present-day needs. Nowhere is the problem quite so acute or so diffi-



This article gives you a vivid picture of network of wires and tunnels buried below city streets

By

JOHN CHAPMAN HILDER

cult as in the little island of Manhattan, thirteen miles long by two wide, the heart of New York City.

Restricted by its river boundaries from expanding along the ground, Manhattan has pushed itself up into the air and down into the rock on which it rests. Its ever changing skyline has become one of the wonders of the world. But though millions who have never visited the city are familiar with the appearance of its giant buildings, few have any idea of its extraordinary underground structure. Even the dyed-in-the-wool New Yorker has but a sketchy notion of what lies beneath the streets.

The sight of men digging up the pavements is so usual that he seldom bothers to ask why. The only time he thinks of such things is on the rare occasions when his water, his light, or his telephone is temporarily shut off. At such times, he condemns the city administration and all its works. As a matter of fact, considering the difficulties to be overcome and the problems to be solved, the wonder is that he gets uninterrupted service on an average of 364 days out of 365. That is another of the wonders of the world—the result of engineering skill and ingenuity, plus constant vigilance.

AS an example of this ingenuity, consider the safeguards surrounding the flow of electric current for light and power. Millions depend on it, not for light alone, but for power to run elevators, subways, street cars, telephone circuits, and the machines in the city's thousands of factories.

Drawing at top suggests the many uses to which the underworld of New York has been put by the skill of engineers. Above, repairing telephone cables, each of which may contain as many as 3,000 separate wires

"What happens," I asked an engineer of the electric light company, "in the case of a building gutted by fire? Isn't it possible for a fire to cut off the lights in an entire block, or a whole district?"

"No," he replied. "Our underground network is so extensive that every block is surrounded by inter-connected electric mains. If one main is damaged, our emergency squads can tap an adjacent one in no time."

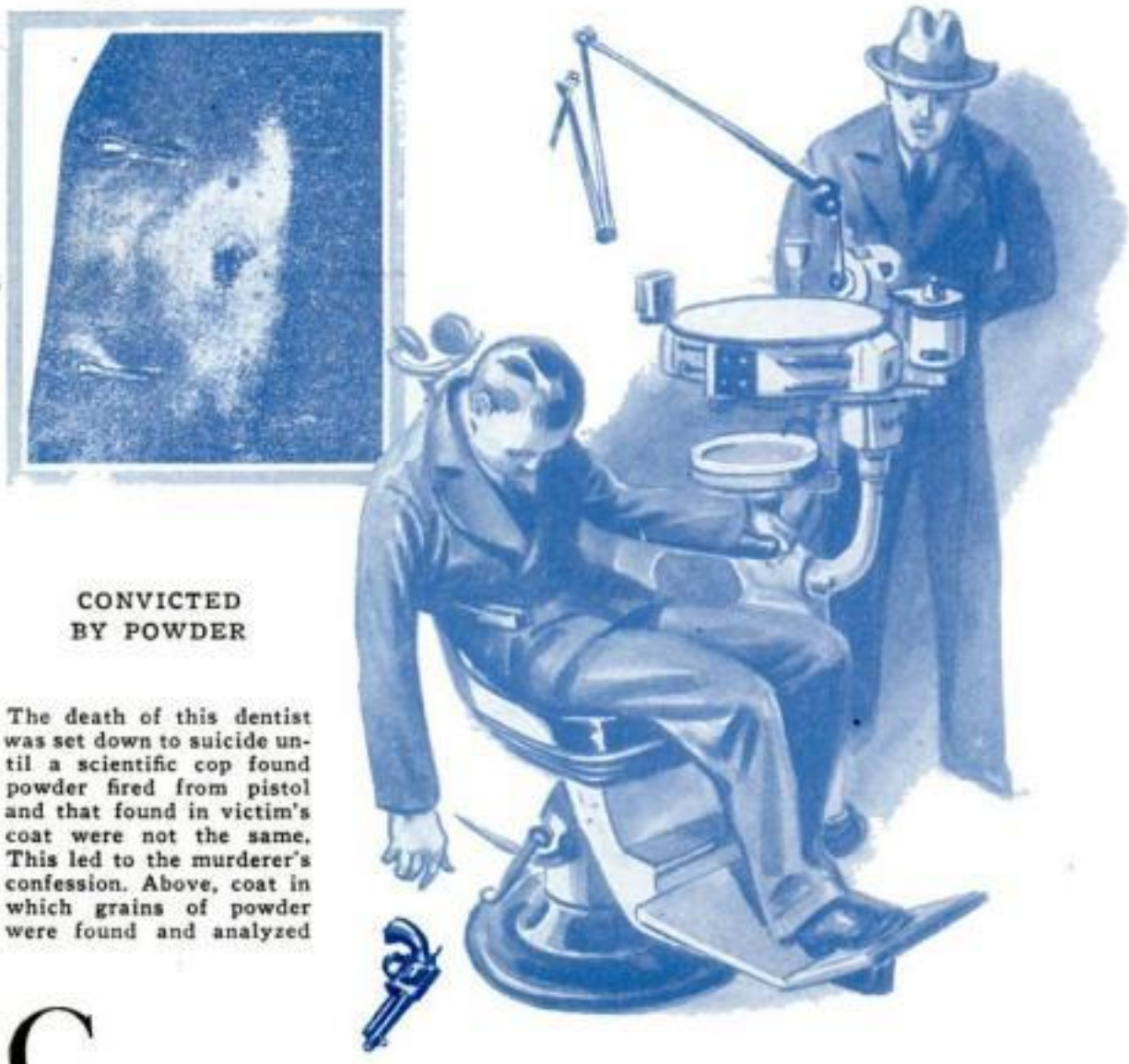
Precautions taken to protect Manhattan against a lack of electricity include four great generating stations, located in different parts of the city, that send high-voltage current, via underground feeder cables, to thirty-odd substations, which distribute it, in reduced voltage, to street mains in their districts.

The four generating plants, though miles apart, are all connected with one another, so that if one should be unable to furnish current required of it, it can draw on one or more of the other three. Four separate high-tension cables, each capable alone of carrying the necessary load, link plant to plant. Each cable follows a different route so that if one is damaged three more are available.

Not only are the generating plants thus united into what amounts to one vast power house, but the sub-stations scattered about the city are similarly interconnected. Each sub-station receives current from two generating plants. Furthermore, all the sub-stations are linked into an endless chain, so that in emergencies they can borrow or lend one another current. *(Continued on page 135)*

Hidden Crime CLUES

Cleverest Crooks Now Who Solves Mysterious



CONVICTED BY POWDER

The death of this dentist was set down to suicide until a scientific cop found powder fired from pistol and that found in victim's coat were not the same. This led to the murderer's confession. Above, coat in which grains of powder were found and analyzed

CHEMISTRY is the new Sherlock Holmes of modern scientific crime detection. By peering into vials and test tubes, studying the shifting rainbow colors of reacting substances, using strange reagents, and plumbing with powerful metal-eating acids secrets held in steel, magic-working detectives now solve mysterious crimes.

One of the most baffling in which chemistry played a part was the weird "Zodiac Murder" at Brandon, Ore.

The wife of Dr. Fred Covell, reputable Brandon physician, was found dead in her home under suspicious circumstances. The discovery was reported by the doctor's brother, a helpless paralytic who spent his days in a wheelchair poring over charts, zodiacs, and horoscopes, absorbed in the "black art" of astrology.

Two physicians, who examined the victim, reported she had been thrown violently about and had died of a broken neck. Unable to move from his chair, the crippled brother could not have committed the crime. Certain clues around the house pointed to Dr. Covell as the slayer. He was arrested, charged with murder in the first degree, and indicted by the grand jury. His conviction and execution seemed certain when Luke S. May, famous scientific detective of Seattle, Wash., entered the case.

May's first act was to have the body of the murdered woman exhumed for examination. In spite of the testimony of the two physicians, he found that the neck had never been broken. This bombshell exploded the hypothesis around which the case against Dr. Covell had been built. Further examination of the body disclosed peculiar marks, like burns, on the woman's upper lip.

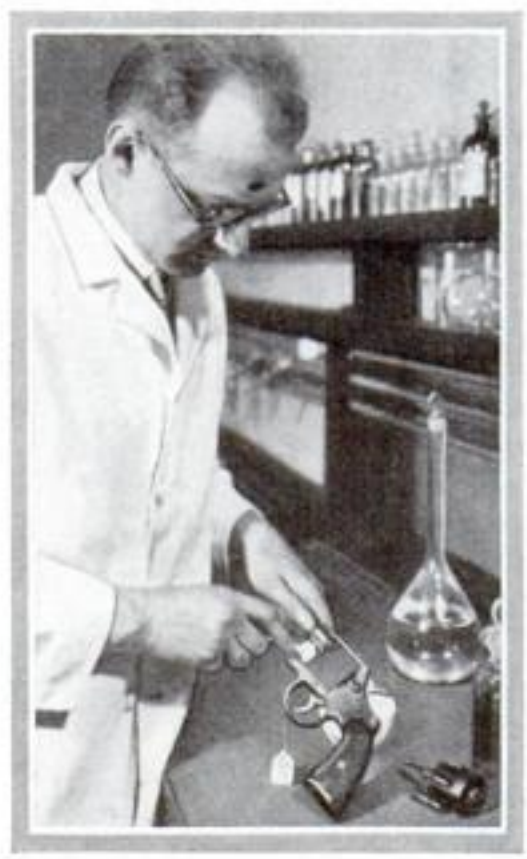
In an improvised laboratory, the detective set to work with test tubes and chemicals. After a long series of experiments, he concluded the strange burns could have been caused by only one agent —ammonia. Later events proved him right. The fiendish slayer had forced the powerful fumes into the lungs of the struggling woman, strangling her to death. But who was he?

In his effort to unravel the mystery, May began cultivating the acquaintance of the crippled astrologer. He found him a man of unusually keen intellect and tremendous will power who had an almost hypnotic effect upon those around him. Among his possessions, the detective discovered curious messages in code, using signs of the zodiac as key symbols.

ALTHOUGH May is a cryptographer of note, he knew practically nothing of astrology. So, with characteristic thoroughness, he began an intensive study of the pseudoscience. When he finished, he reëxamined the notes, grouped the symbols, found the key to the baffling code, and uncovered one of the most fantastic and diabolical murder plots of criminal history.

Sitting in his wheelchair, the sinister cripple had marked seventeen people for death. Each murder was cunningly planned to be a perfect crime, with planted clues pointing to an innocent person. Casting the horoscopes of his victims, the astrological assassin had set the time of their deaths for the hours when the stars boded most evil for them.

Mrs. Covell had been the first on the list. The actual slaying was carried out by



MAGIC BRINGS BACK FILED-OFF PISTOL NUMBERS

At left, Dr. C. W. Muehlberger, of the Chicago Crime Detection Laboratory, brings back, with his chemicals, the serial number filed off a murder gun as at top. Immediately above, two views of the same part of the pistol with which Jake Lingle, Chicago newspaper man, was killed, showing numbers removed and restored

Bared by Chemist's Magic

Baffled by Modern Scientific Detective Murders with Test Tube and Retort

By
EDWIN W. TEALE

a sixteen-year-old nephew under the domination of the astrologer. The code messages, which May deciphered, had passed between the two. After having assisted in sixteen murders, timed by the zodiac, the young nephew had been scheduled as the seventeenth victim by the inhuman plotter.

Each of these deaths was calculated to enrich the astrologer. Mrs. Covell would leave her husband considerable property, which, when the doctor was executed as the result of planted clues, would be inherited by his brother. Before Luke May arrived on the case, with his scientific methods and painstaking chemical tests, the plot was succeeding. His revelations forced confessions from both the astrologer and his young tool, freed Dr. Covell, and sent the malignant plotter to the gallows.

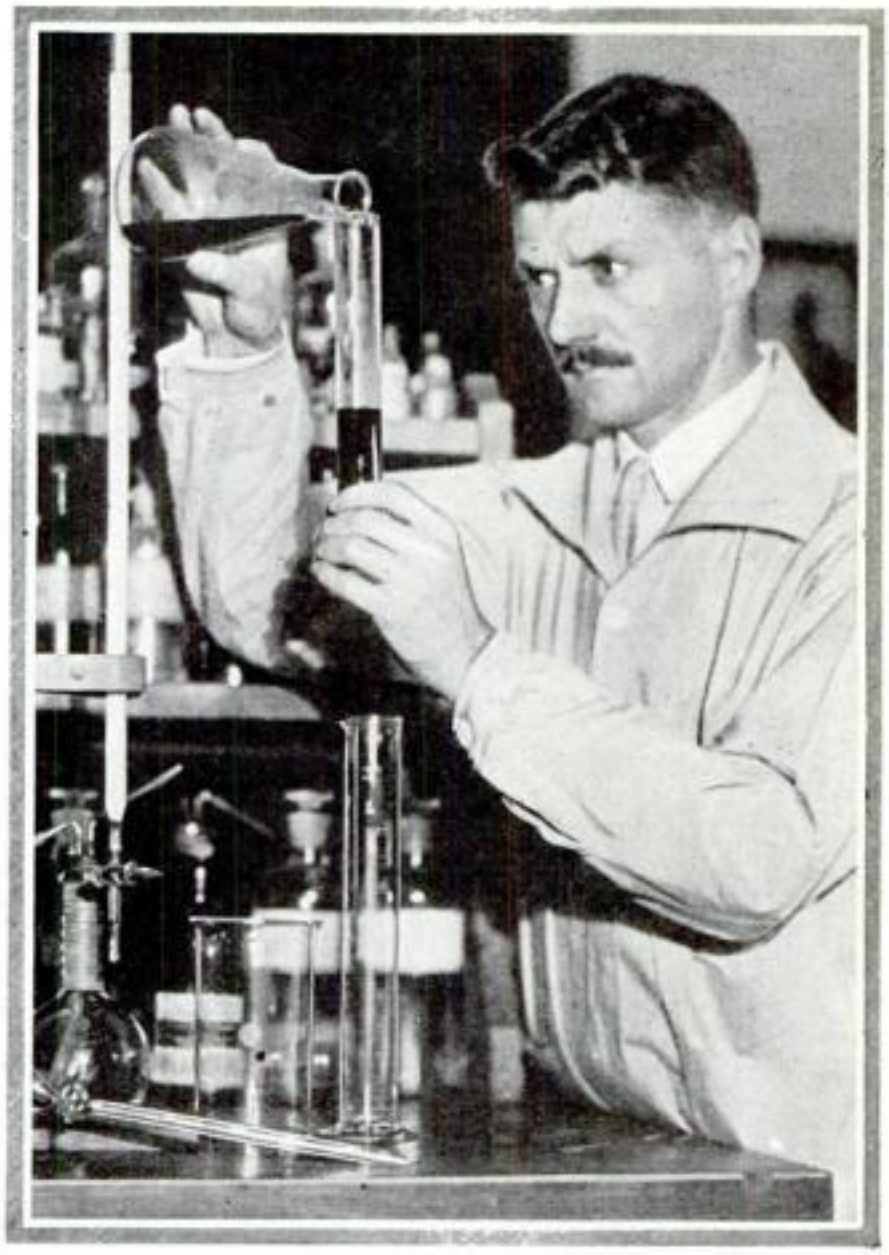
ONE of the remarkable aspects of chemistry in crime detection that I learned while interviewing scientific sleuths from fifteen cities in preparation for these articles is its many uses. At every turn, it is depended upon to give vital information. Is a stain blood or paint? Is the ink used in an anonymous letter the same as in a suspect's fountain pen? Was poison administered in a mysterious death? Is the hair clutched in the dead hand of a victim torn from the head of a young or old assailant? What are unknown fluids, metals, and fibers, which may prove links in solving a mystery? For answers to these and a host of other questions, the scientific detective turns to his Bunsen burner, his retort, and his test tube.

At New York City, an unusual mystery in which death came out of the sky was solved a few months ago by chemical tests. A seaplane, landing in fog on upper New York Bay, crashed into a rowboat, drowning the occupant, and flew away in the dense haze. Witnesses were too far away to give anything but the vaguest description of the death plane, so the detectives had almost nothing to work on.

They carefully examined the boat, and near the oarlocks discovered a small patch of green paint, scraped from the float of the fatal seaplane. They followed this slender clue. Officers raced to all flying bases in the vicinity. At one, they found a seaplane with a long fresh scratch under its green landing gear. Analyzed chemically, the paint on this pontoon and on the overturned rowboat were found to be identical and the case was quickly solved.

In Jesse James' day, an outlaw kept his favorite pistol and nicked the handle for every victim. Today, the gunmen of the underworld discard their weapons after each killing, filing off the serial numbers to prevent their being traced. At the factories where the guns are made, these numbers are indented into the steel.

To destroy them, the gangsters use files or emery wheels, cutting into the metal as far as the stamped-in figures penetrate and leaving the surface level and smooth. The numbers have been completely cut away. Yet, by their scientific magic, the experts in the crime-fighting chemistry laboratories can make them reappear!



Dr. Pacini, chemist of the Chicago Crime Prevention Laboratory, can tell age and sex of victim from a single hair by submitting it to chemical action. Also the faintest traces of poison and clues in blood or clothes can be found

DRIVEN TO KILL

A fiendish cripple planned seventeen murders and forced his nephew to act in his place. One victim died and others were to follow, but science showed how the murder was committed and got a confession from the boy

ONE day, when I was talking to Dr. C. W. Muehlberger, the noted chemist-detective of the Scientific Crime Detection Laboratory in Chicago, a blue-barreled gangster's gun that had spit recent death was brought in by the police. Every number had been filed away. Leading me to the chemistry room, Dr. Muehlberger demonstrated the legerdemain by which he "etches" back the obliterated figures.

Into a bottle of brilliant blue-green fluid, he dipped a swab. This he rubbed back and forth over the filed surface on the frame of the gangster's gun. Again and again he applied the powerful copper-chloride in its acid solution. Five minutes passed; then ten; then fifteen. Fine gray lines were appearing in half a dozen clumps or clusters. They were taking shape. They grew into the faint outlines of numerals. Five minutes more and the number 685422 stood out plain enough to be photographed.

"How do you explain it?" I asked him in amazement.

"At the time the numbers are indented

into the metal," he told me, "the pressure breaks up the steel crystals under each figure. The acid, eating into the metal, leaves each edge of the crystals or fragments standing out as a gray line. Where the crystals have been broken up, there are naturally more lines than elsewhere, just as the lines are close together on a contour map where the ascents and descents are steep. These 'etched' lines form an almost solid mass where the indented figures break up the crystal structure and thus reproduce the original numbers."

At the time Alfred ("Jake") Lingle, the *Chicago Tribune* reporter, was killed, Dr. Muehlberger set a record for speedy work in etching back the numbers on the assassin's gun. Two hours after he received the weapon, he was in long-distance telephone communication with the Connecticut factory where the weapon was made, and, by nightfall, it had been traced to the store where it was sold.

Besides copper-chloride, he told me, other potent chemicals, such as copper sulphate, ammonium persulphate, picric acid and nitric acid dissolved in alcohol, are employed in etching. The numbers on cheap steel can be etched back quickly; with high-grade metal it takes longer.

In still other ways chemicals play a dramatic part in solving murders that result from shooting. Witness the sensational "Tweed-Suit Suicide Case" in the Southwest, a few years ago.

On the day after Christmas, a well-to-do dentist was found sprawled in his own dental chair, a bullet through his heart. An old family revolver, with one cartridge fired, lay beside his lifeless hand. His wife reported he had been in poor health for some time. He was known to have suffered financial reverses. His death was booked as a suicide and would have become a closed incident but for the keenness of a young detective from the coroner's office.

AROUND the bullet hole in the dentist's coat, he noticed the powder burns in the nap of the tweed fabric. Sniffing the garment, he caught the sharp, acrid odor characteristic of smokeless powder. Then he examined the revolver. The ammunition it contained, including the discharged shell, was of the black powder, not smokeless type. The slayer, after killing his victim, had planted the dentist's own revolver, with one cartridge fired, beside the body. But his cunning had overlooked one thing—the fact that the powders in the cartridges in the two guns were different.

Chemical tests verified the suspicions of the detective. Nitrocellulose, a constituent of smokeless but not of black powder, was found in the unexploded grains embedded in the cloth. An investigation brought out the fact that the dentist's wife had a secret lover. Detectives searched the room of this man and found a revolver hidden in a bureau drawer. The markings it made on test bullets were identical with those found on the lead extracted from the body of the victim and the slayer confessed to his crime.

Chemist and police officer examine the axe and bat used in Brooklyn murder

In another remarkable case in Vienna, Austria, unburned powder grains adhering to a bullet were identified by chemical examination after having lain in the head of a murder victim for nearly forty years.

Because the kind of powder used in a murder frequently is important in pinning the crime to a suspect, scientific sleuths keep for comparison purposes all explosives in common use. In May's Seattle laboratory, for instance, there are samples of practically every powder manufactured in the United States during the last fifty years.

HOW one man was saved from prison by such a comparison of explosives was told me by Col. Calvin Goddard, director of the Chicago Laboratory. A bomb, made of loosely-packed dynamite with the wrappers removed, was found placed under the bedroom window of a wealthy farmer in northern Illinois. Fortunately it had failed to explode.

In the toolshed of another farm, half a mile distant, a number of sticks of dynamite were discovered. The owner, who recently had quarreled with his neighbor, was immediately suspected of planting the bomb and placed under arrest. A strong circumstantial case was built up. His conviction seemed likely when samples of the loose dynamite in the bomb were submitted to the Chicago laboratory. The analysis of the chemists showed the explosive was "Hercules 60." The dynamite found on the suspects farm was "Du Pont 40." He was immediately freed.

When the scientific detective comes to grips with a modern Borgia, stealthily working with deadly vials of poison, his ace card is chemistry. Rare, venomous compounds, that cause the victims to waste away with mysterious maladies or to die with apparently normal diseases, can be detected only by chemical research. A new test for arsenic, the most frequently used poison, in exhumed bodies was recently added to the scientific lore in this branch of crime fighting, under dramatic circumstances in Great Britain.

In the little town of Bodmin, near the southern tip of England, a woman was accused of having poisoned her sister. The body was exhumed, tests showed arsenic present in the remains, and the suspected sister was held for trial. In court, defense lawyers sprang a surprise. They admitted arsenic was in the body. But they proved that the soil of the cemetery, as is not infrequently the case in mining regions, contained quantities of the drug as a natural constituent! Had the drug, as they contended, entered the body after burial, or had it been present at the time of death?

To answer that question, Dr. Gerald R. Lynch, the famous criminological chemist of Scotland Yard, was brought into the case. He took hairs from the head of the dead woman, washed them many times and then split them open and made a chemical examination of the interiors. Inside, where it could have been deposited only during life by the poison circulating in the victim's blood, he discovered remains of the fatal arsenic.

IN OTHER ways, also, chemical analysis of hairs often yields important facts to the scientific detective. Drugs, gases and bits of substances that adhere to them may reveal the secret of the recent whereabouts of a victim or suspect.

Again, I was informed, the approximate age of an unknown person can be determined by dissolving the hair roots in a solution of caustic potash, or lye. The younger the person, the more quickly the roots dissolve. A child's hair dissolves almost immediately while the hair from an old man may require several hours. If you take a woman's hair and a man's, both of the same diameter, tests have shown that the woman's will dissolve more quickly. As hairs are frequently found clutched in the hand of a slain person or clinging to the discarded garments of a fleeing slayer, such information is vital.

A sensational case, in which the murderer himself made use of caustic potash to hide his crime, took place early in 1927 when two women, Sarah Brownell and Selma Bennett, were butchered by a fiendish ax slayer in Brooklyn, N. Y. Notified of their disappearance, detectives searched the neighbor- *(Continued on page 140)*

Next Month

Fighting the underworld with microscopes! . . . Unraveling baffling mysteries with clues too small to see! The next installment of this remarkable series will give you thrilling stories and first-hand facts from the case-books of scientific master detectives. Watch for it in the December issue, out November 2. Order your copy in advance from your newsdealer

Electric Key Fires Old Volcano

Man-Made Eruption in Lassen Crater Seen for Miles

WITH an explosion that threw columns of smoke five hundred feet into the air and detonations that reverberated thunderously among the surrounding peaks of the Cascades, Mount Lassen, California's dying volcano, suddenly sprang into life recently, with the strangest eruption ever witnessed. For probably the first time in history, the spectacle of a mighty volcanic eruption was reënacted by man.

With rumblings and heavy explosions the aged peak flung a plume of smoke high above its 10,000-foot summit and belched forth fire, smoke, and steam, in a spectacular display visible miles away. This man-made volcanic demonstration was patterned after Lassen's 1915 eruption which destroyed thousands of acres of timber and devastated the countryside for a distance of ten miles.

Behind the brilliant display that thrilled thousands of spectators lay weeks of patient study and preparation by pyrotechnic experts. For days, pack trains, laden with rockets, mortars, and a vast quantity of other equipment, including 6,000 pounds of powder, toiled up the steep trail to the summit.

Crater of Mount Lassen ablaze as the result of the explosion by electricity of a quantity of fireworks designed to imitate a real volcanic eruption

Fred G. Hitt, engineer in charge, placing bombs used in the man-made eruption

Closing the electric switches that set a volcano in action

These caterpillar smokes, whirling skyward over Mount Lassen, created columns of white smoke in imitation of the steam jets from the crater of an actively erupting volcano

The artificial eruption, for which all this material was used, was under the control of a single operator seated at an electrical keyboard far from the point of explosion.

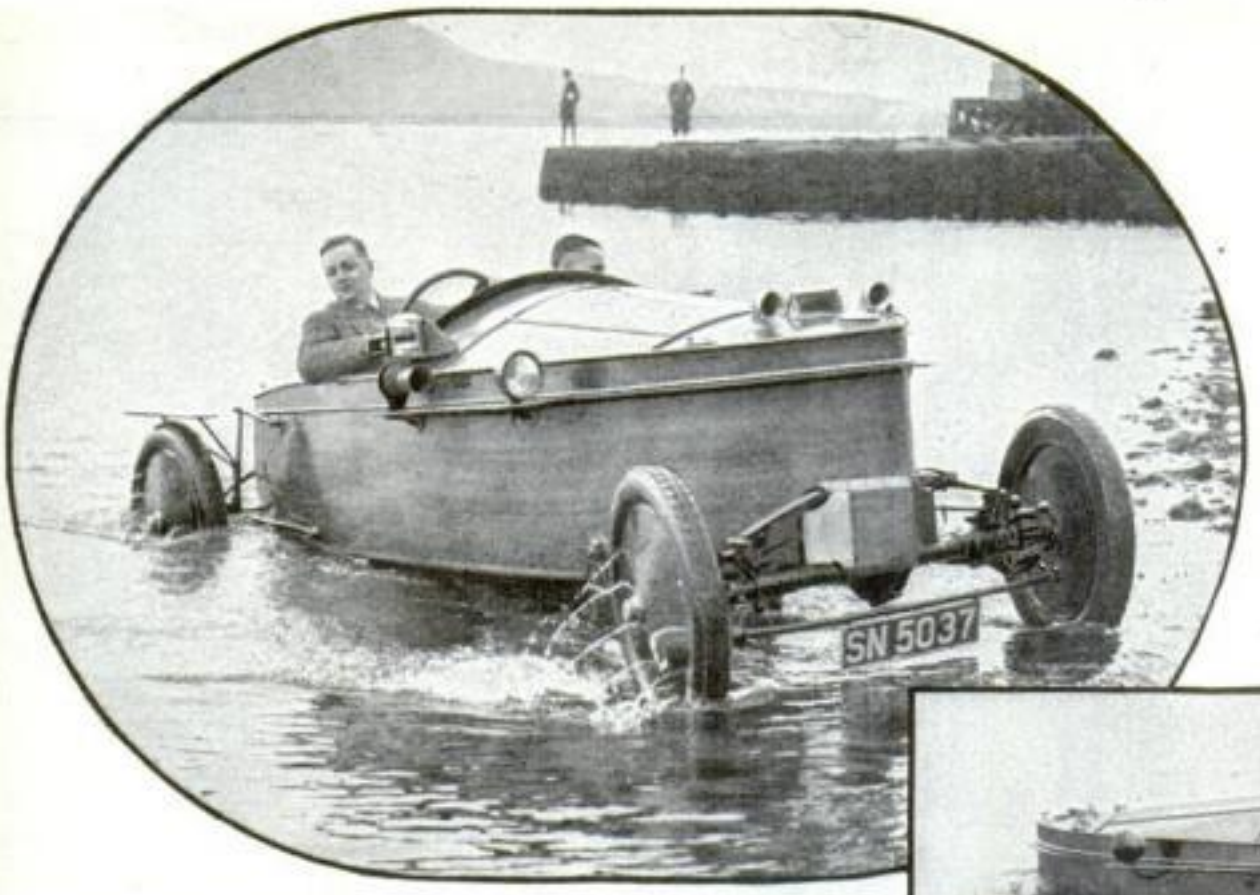
THE DISPLAY began at four P. M., following the formal dedication of the new Lassen Volcanic National Park by Dr. Ray Lyman Wilbur, Secretary of the Interior. Waiting at his electrical switchboard on the mountainside some distance below the crater, Fred G. Hitt, engineer in charge, watched for the signal rocket to be fired from Kings Meadows, five miles away, where the services were held.

When he heard a distant boom, and saw a puff of smoke float upward from the meadow, his hand moved over the controls. Upon the contact of a single switch, a mighty roar sounded from the old volcano's top.

Following this activity, old Lassen seemed to quiet down for a period. But at eight-thirty o'clock in the evening, Engineer Hitt, working the electrical controls, again released tons of pyrotechnic material from the crater.

Geologists are of the opinion that Mount Lassen will never again flare forth in real eruption, although jets of steam still issue from among its heated rocks.

Water and Land Alike to This Amphibian Motor Car



CARS that travel either on land or water are a favorite field of inventors, and a Glasgow, Scotland, man recently demonstrated the latest amphibian. This motorboat-on-wheels proved its ability by negotiating the road from Glasgow to Gourock and back, crossing the Bay of Cardwell en route—in all, a trip of nearly fifty miles. One of the accompanying photographs shows it part way across the bay, and the other as it emerged on the far shore to continue by road. One feature of the machine is the fact that the engine and transmission and differential are all enclosed in the watertight boatlike body. Instead of fenders over the rear wheels, the odd machine is provided with flat surfaces that serve as steps to board it while it is tied up at a wharf.

At right, amphibian motor car crossing Bay of Cardwell and above, the same car as it emerges from water and is ready to take the road

USE ARTIFICIAL SILK TO STRING VIOLIN BOW

FIBERS of artificial silk replace horsehair in a new violin bow invented by a Greeneville, Tenn., musician. With this synthetic fiber it is necessary to use resin only occasionally on the bow. The man-made "horsehair" is also said to be more durable, less expensive, and more pleasing in the tone it gives upon the strings. In making the first radical change in a violin bow since its invention about 1780, the designer of the present improvement took his idea from silk-strung Chinese instruments.

SPRING PIN KEEPS NUT FROM SHAKING LOOSE

TO KEEP it from coming loose, a new lock nut is provided with a spring pin, bearing a pointed tip. The point resists any tendency of the nut to unscrew by biting into the threads. When it is desired to remove the nut, however, sufficient pressure with a wrench throws the pin into the position shown by dotted lines in the picture. The nut then unscrews easily. Lock nuts of the new type are available in sizes to fit any standard bolt, and are said not to damage the thread even by repeated use.

IDENTIFICATION SEAL SPEEDS RETURN OF LOST ARTICLES

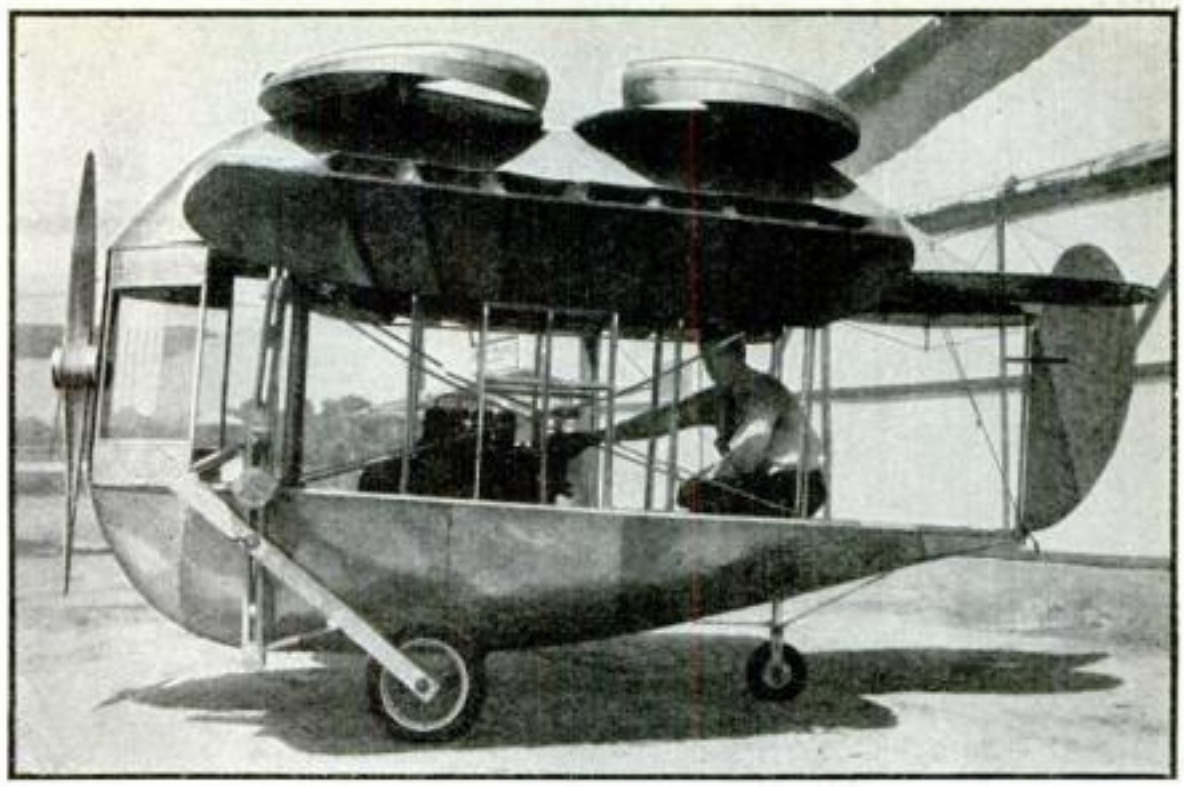
GLOVES, pocketbooks, and other small articles are guarded against loss by a new identification seal of gummed paper, just patented. A conspicuous label instructs the finder to break the seal. He finds within the name, address and telephone number of the owner, and a postage stamp for his convenience in sending notification. Thus articles left on trains and elsewhere are speedily returned, without recourse to "lost and found" departments of the transportation company or a newspaper.

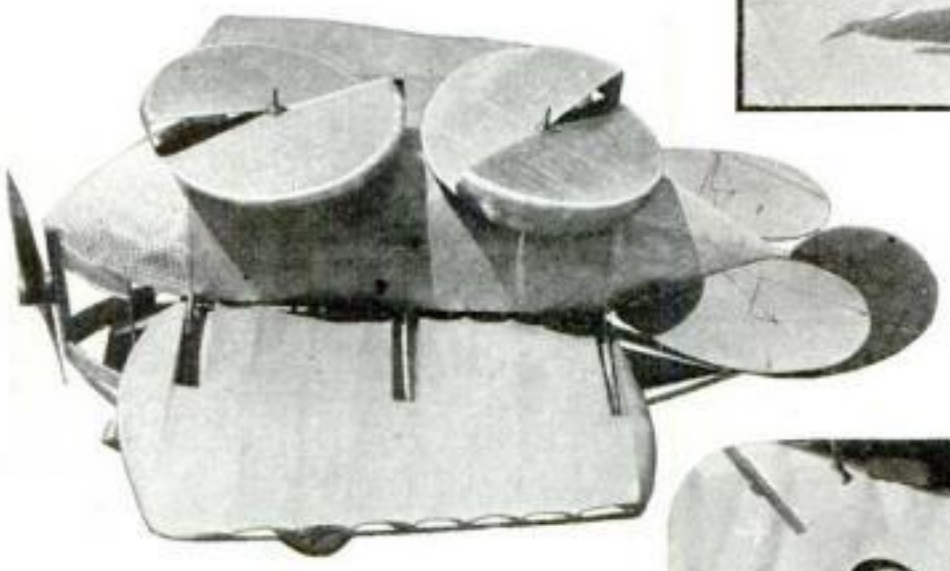
NEW FARM TOOL STOPS SOIL EROSION

A NEW farm implement, for want of a better name, is being called a "waffle" machine. Its operations leave a field looking much like a huge waffle. Cultivator shovels, working up and down as the machine moves forward, scoop the dirt into small hills and leave holes that will hold two or three gallons of water. The water, thus held, is given a chance to soak into the ground. A set of ordinary cultivator shovels are fastened to the machine just in front of the digging shovels, and can be used if necessary. Surface soil in a field thus cultivated does not wash away after heavy rains. The pockets dug by the cultivator average 10,000 to the acre. The machine was invented by R. H. Davis, soil erosion specialist at the Fort Hays, Kansas, agricultural station.

TWO WHIRLING BUTTONS MAY LIFT NEW PLANE

HALF helicopter and half airplane is a strange flying craft that Harry Cordy, Los Angeles inventor, has built. Two huge "buttons" which are designed as a new form of lifting propellers placed on top the unconventional plane are intended to revolve and help lift it from the ground. In forward flight it would be propelled by a propeller of standard design. Slow take-offs and landing, made possible by the spinning buttons, would make the plane safer than standard high-speed aircraft, according to the designer. A four-cylinder motor provides power for propeller and buttons. At this writing, Cordy was preparing to test his machine in actual flight and expressed his confidence in its vertical flight possibilities.





This strange aircraft, seen above with its inventor, Harry Cordy, Los Angeles, has two buttons on top to help lift it. At left, a top view of the machine

SMOKING SET HOOKS TO CAR'S STEERING POST

WHEN the driver of an automobile wants to smoke, a new smoking set mounted on the steering column supplies him with a cigarette. It holds a standard sized pack, together with a box of safety matches and a removable ash receiver. Attached in a few minutes, the set is finished in chromium plate to harmonize with the car's fittings. Its advantage lies in the fact that it is so mounted as to be in reach of the driver and he can light a cigarette without taking his eyes off the road.

A smoking set for the car attaches to the steering post within easy reach of the driver's hand

EATS GLASS AND STRING TO AID STOMACH STUDY

GLASS beads, strands of knotted thread, and even tiny pellets of gold is the diet of Frederick Hoelzel, Chicago, Ill., university student, since he offered to aid physiologists of the University of Chicago in research work on indigestion. The foreign objects are mixed with his meals, and his stomachaches come under laboratory scrutiny. They are no novelty to the subject of this unusual experiment; he volunteered for the tests because he already suffered from severe digestive troubles.

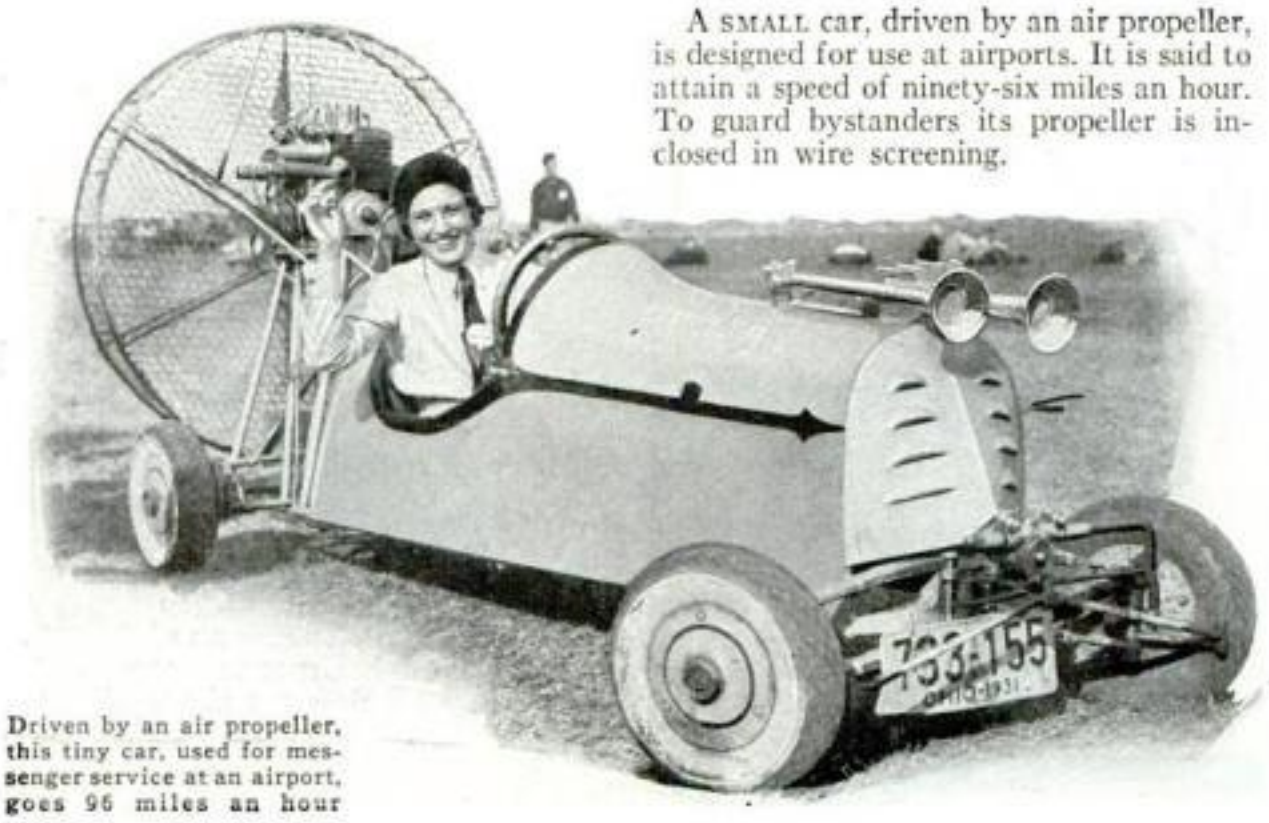
LUMINOUS TAB HELPS YOU PICK RIGHT KEY

A TAB that shines in the dark slips over your front door key and makes it easy to pick out from the rest when entering the house at night. The tab is permanently attached to the key by a spring clip. The New York City inventor has also devised tabs of different colors to identify the other keys.

The luminous tab clips to house key and helps you select it in dark hallway

TINY AIRPORT CAR HAS AIR PROPELLER

A SMALL car, driven by an air propeller, is designed for use at airports. It is said to attain a speed of ninety-six miles an hour. To guard bystanders its propeller is inclosed in wire screening.

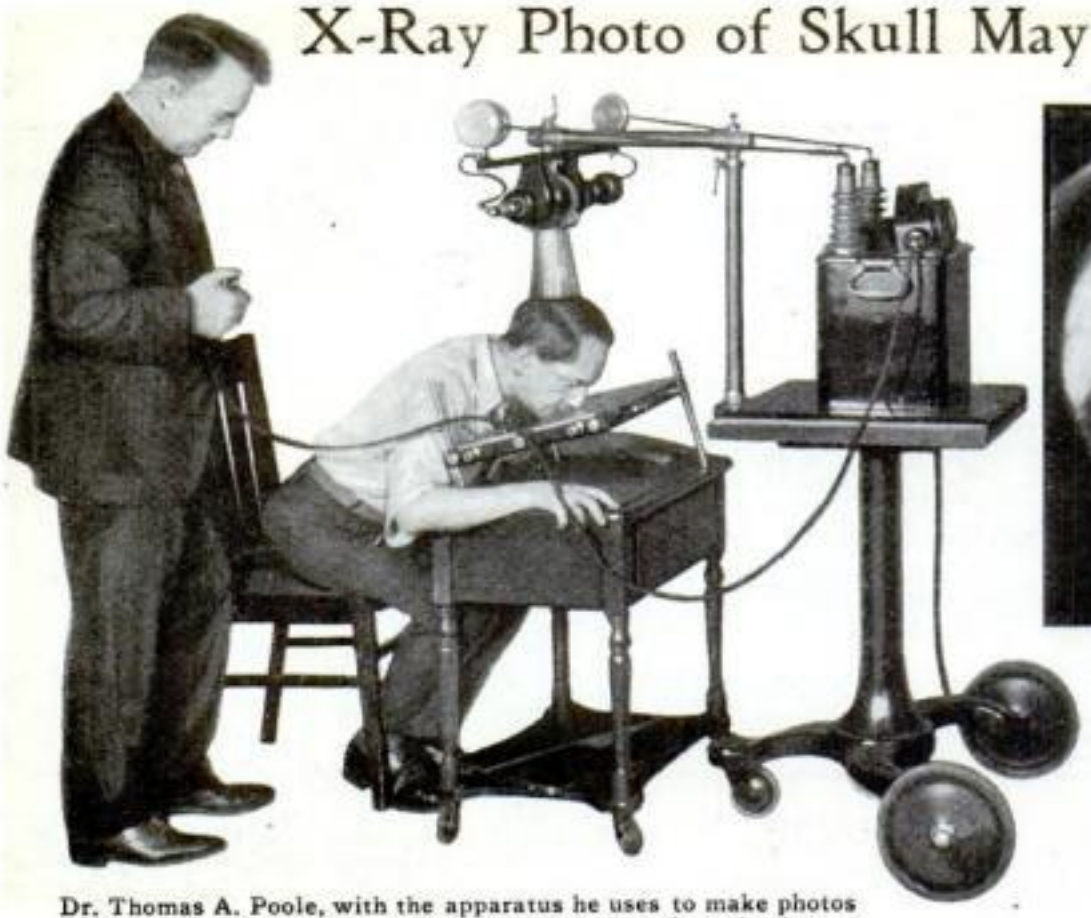


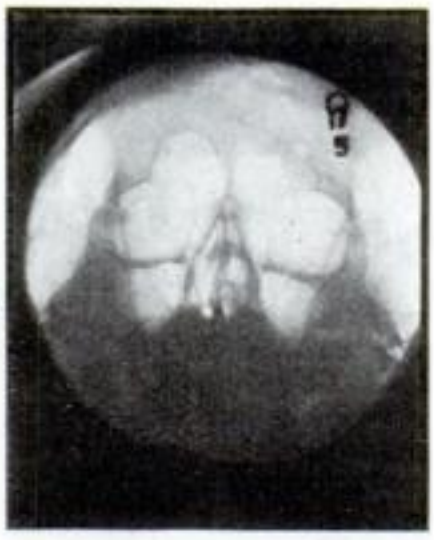
Driven by an air propeller, this tiny car, used for messenger service at an airport, goes 96 miles an hour

COLORED LIGHTS SEEN BEFORE EARTHQUAKE

WHEN a destructive earthquake rocked Japan late last year, many witnesses reported seeing red, blue, and yellow lights in the sky just before the shock. Such reports have hitherto been discredited by scientists, but this time one Japanese scientist, K. Musya, happened to see the lights himself. In consequence he set out to collect statements from other observers, and has just announced his results. His report cites more than 1,500 observations of the strange "earthquake lights," seemingly too many to be dismissed as imaginary. It has been suggested that these lights may be an electric phenomenon similar to the aurora.

X-Ray Photo of Skull May Be Used to Identify Crooks





Dr. Thomas A. Poole, with the apparatus he uses to make photos of the skull. Upper right, typical X-ray picture of man's sinuses

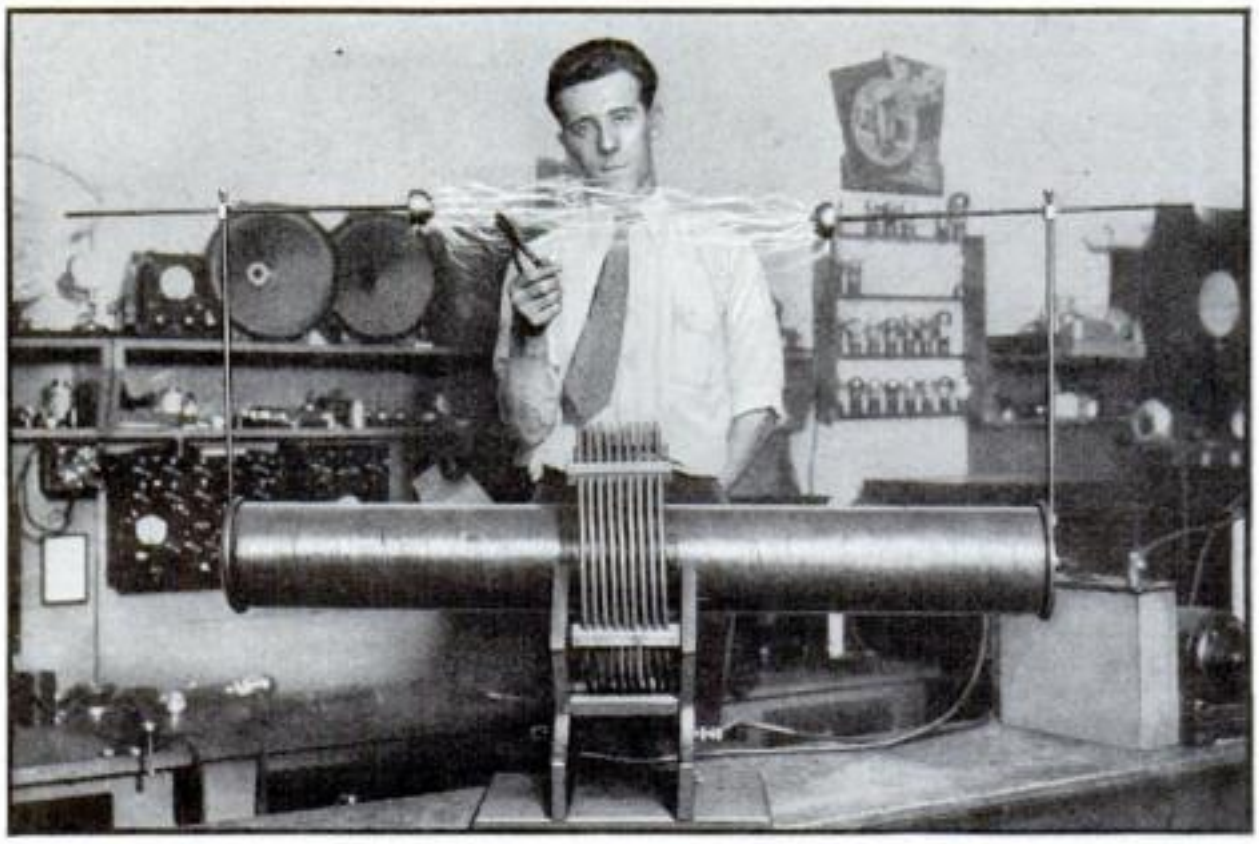
X-RAY photos of the sinuses of the skull of a habitual criminal may identify him, one of these days, instead of his fingerprints. Dr. Thomas A. Poole, of Washington, D. C., who proposes this method of identification, declares that he has examined these skull cavities in thousands of persons without ever finding a pair alike. Even twins show a different confirmation of the bone arches. A criminal might injure his finger tips accidently or purposely, and destroy the pattern of lines, but the telltale pattern within his skull would serve to identify him as long as he lives and even after death. Dr. Poole suggests that police stations keep a library of sinus X-rays, taken like fingerprints immediately upon the arrest of a first offender. Taking such photos would require little time, and a vast number of them could be stored in a small space for ready reference.

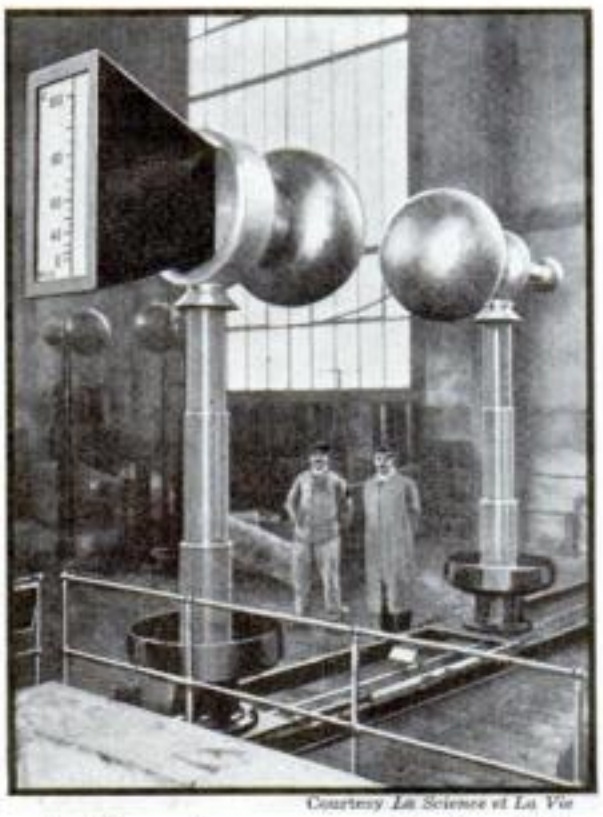
CLOTHES, DRYING IN AIR, DAMAGED BY SMOKE

NO LONGER a mystery are the rents and holes that appear without warning in cotton garments—even relatively new ones—hung out to dry during the winter. This phenomenon, known as "winter damage," is now explained by the U. S. Bureau of Standards after an investigation of several months. It has been traced to the smoke which contains a chemical, sulphur dioxide, that forms sulphuric acid when it comes in contact with moisture in the air and on clothes. The remedy for winter damage is to add a small quantity of calcium bicarbonate to the final rinse water.

USE BALLS TO MEASURE MILLION-VOLT CURRENT

WHAT it takes to measure a million volts of electricity is seen in this photograph at right, taken in a high-tension laboratory at Lyon, France. A pointer within the box on the left-hand pedestal travels behind the translucent scale, which is graduated in thousands of volts. Overflow currents leap in a spark between the two balls, which are mounted on insulated pedestals eleven feet high.





Courtesy *La Science et La Vie*

A million volts are measured by these balls

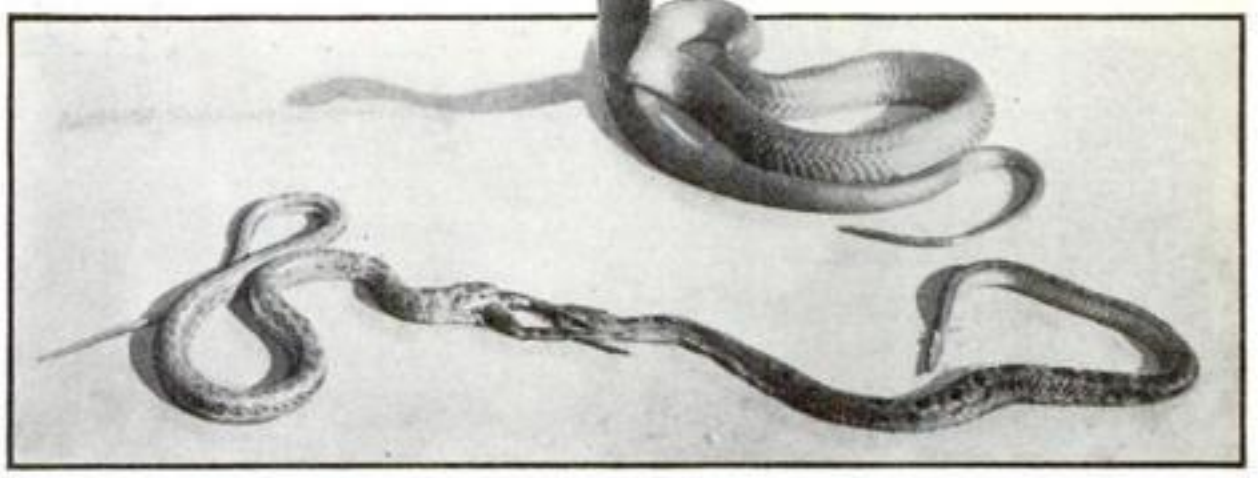
STUDIES ELECTRICITY WITH BIG TESLA COIL

A GIANT Tesla coil that he built himself helps Harvey Wilson, of Springfield, Mo., to study electricity. Thirty-inch sparks leap from its electrodes. Despite their tremendous voltage, they are harmless to human beings because of the small amount of actual current flowing. Electricity to run the forty-inch coil comes from a transformer which in turn is attached to the regular 110-volt lighting circuit. To make the coil of the transformer, Wilson wound thirty-two miles of wire by hand. In the circuit between transformer and Tesla coil is a homemade condenser that Wilson constructed from old photographic plates and tinfoil, immersed in castor oil. The rotary spark gap that serves to interrupt the circuit is also homemade, and a quarter-horsepower electric motor drives it. In the picture above Wilson is seen with his apparatus in action and a spark of electricity leaping the gap between the electrodes.

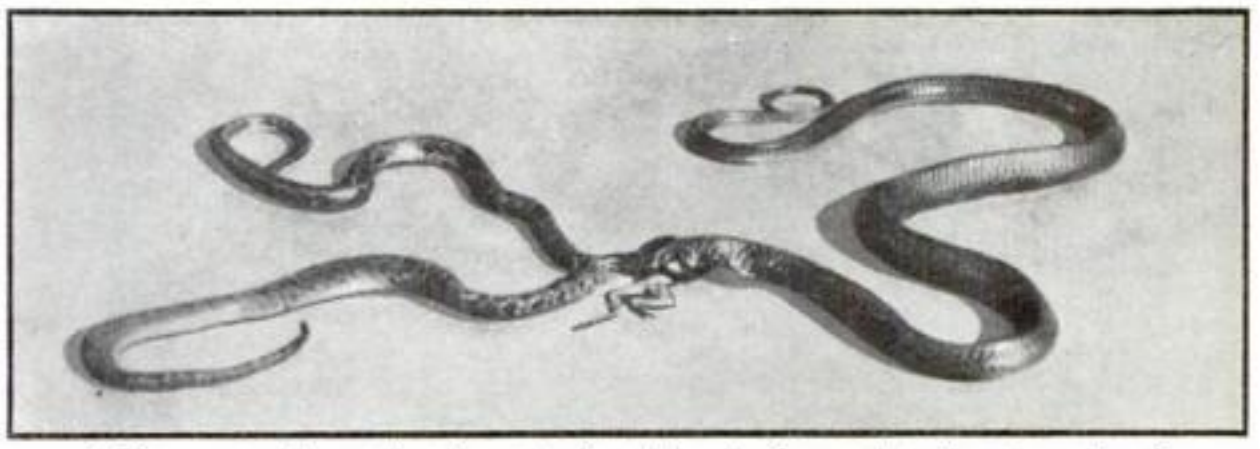
SALVAGE WORKERS NEAR GOLD LOST AT SEA

NEARER and nearer are salvage workers coming to $5,000,000 in gold believed to lie within the strong room of the sunken liner *Egypt* off the French coast. Treasure hunters of the salvage ship *Artiglio II* are now raising twisted masses of metal wrenched from cabins on the liner's hurricane deck, 400 feet below the surface, in order to get at the supposed riches. Within a short time they will know whether the gold, for the recovery of which so much time and money have been spent, is there. The *Egypt*, on its way from London to Bombay with the bullion, was rammed and sunk by another ship in 1922. Last year the ill-fated salvage ship *Artiglio I* was blown up by a premature dynamite explosion during operations. Undaunted, divers of the *Artiglio II* resumed the task with armored steel suits.

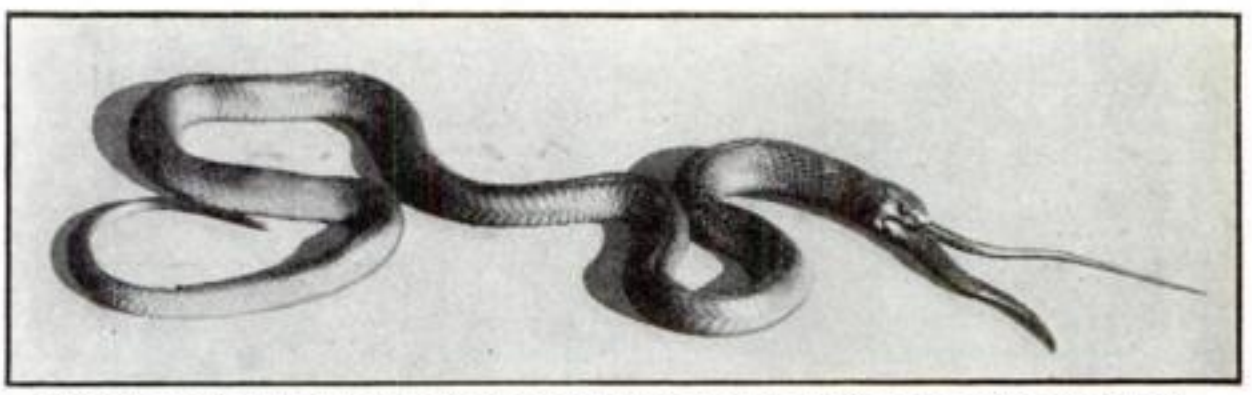
RARE PICTURES OF SNAKE AT DINNER



1. A night adder and a schaapstecker, poisonous South African snakes, dispute over a frog

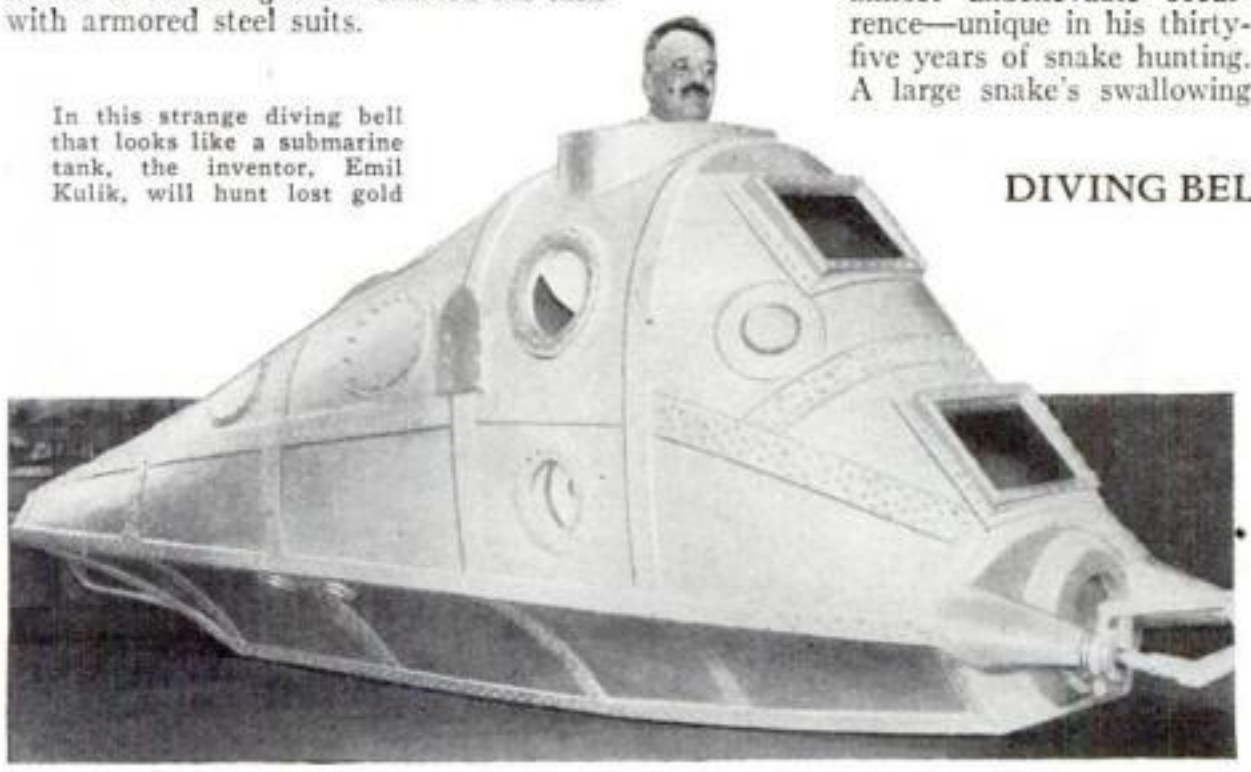


2. But a cape cobra settles the matter by seizing the frog and starting to swallow it



3. That wasn't enough for it so it closed its fangs over the small snakes and downed them

THE three photographs reproduced above, showing an amazing episode in which a cobra devoured two smaller snakes and a frog all at once, were taken by F. W. Fitzsimons, director of the Port Elizabeth, South Africa, Museum. The lucky photographer happened along with his camera just in time to preserve a record of this almost unbelievable occurrence—unique in his thirty-five years of snake hunting. A large snake's swallowing capacity, however, is remarkable. A serpent with a head no larger than a man's thumb, for example, can swallow a full-sized rat. This is possible because of the flexibility of the ligament that connects its jaws, allowing them to spread to great width when necessary. Equally flexible is the skin of the throat, and the snake's prey is forced down its gullet with a series of violent forward contractions of its muscles. The swallowing capacity of the python is, of course, proverbial.



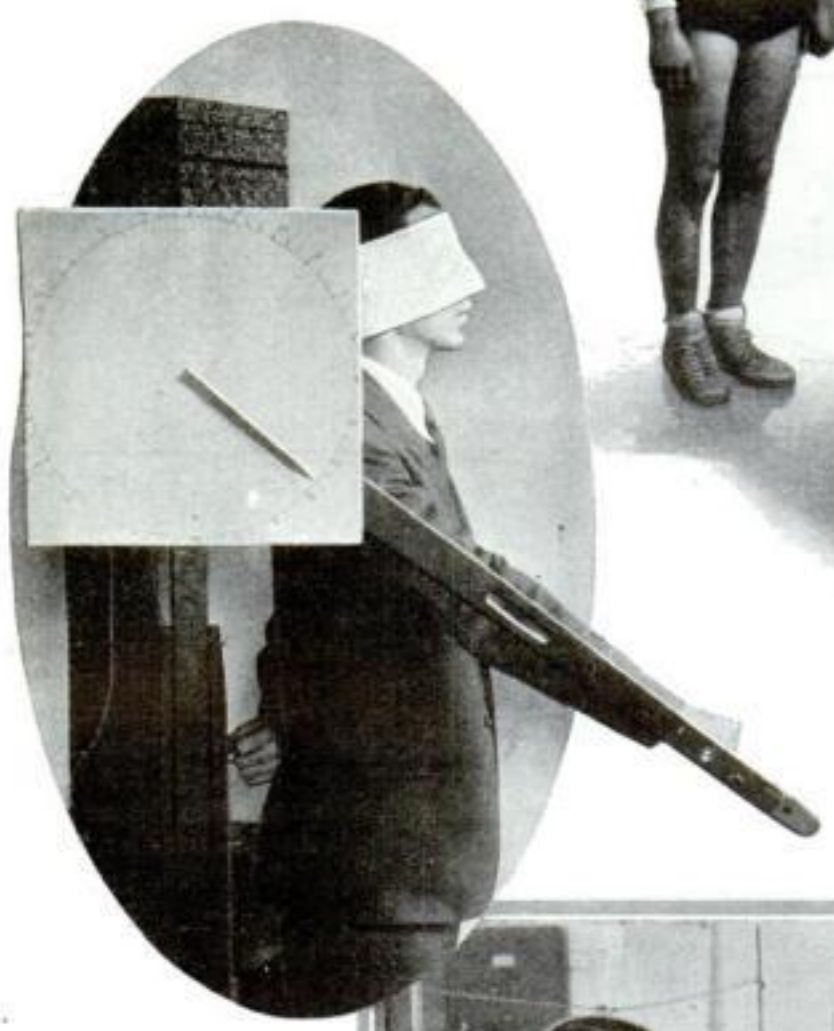
In this strange diving bell that looks like a submarine tank, the inventor, Emil Kulik, will hunt lost gold

DIVING BELL "SUB" TO HUNT TREASURE

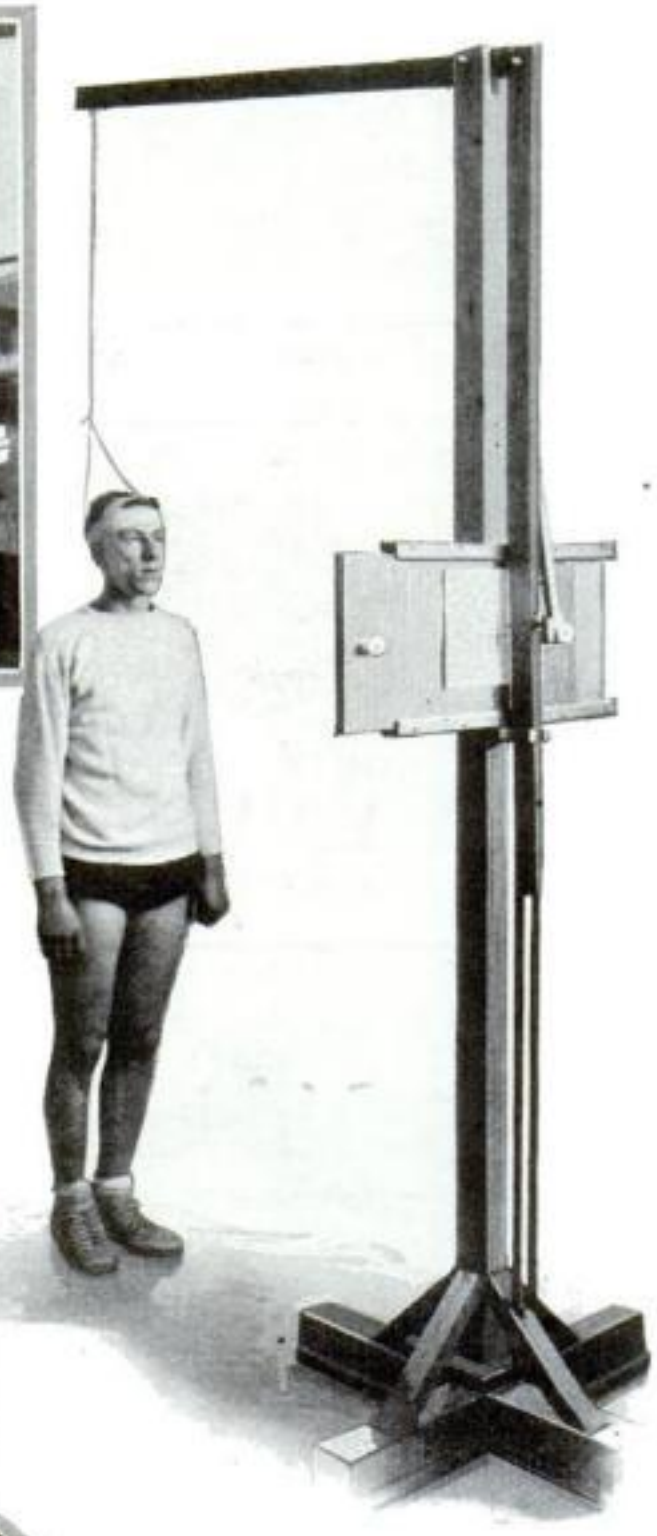
A HYBRID between a submarine and a diving bell is the strange apparatus that Emil Kulik, of Brooklyn, N. Y., has built to hunt for sunken treasure. However, it has some features to be found in neither. Within the shell of steel and glass are oxygen tanks to supply air to the single occupant while he is beneath the waves. Movable arms, operated by compressed air tanks inside the shell, are designed to reach from the front and seize objects to be brought to the surface. The device is now on exhibition prior to its first practical test, which Kulik expects to make within a few weeks. It took the inventor two years to build the apparatus.

Illinois *Seeks New* RED

Ability of candidate for football squad is tested by flashing lights and key signals. The athlete is graded according to his accuracy and speed



Blindfolded, the student raises pointer fastened to arm to a point on a graduated circle. With eyes open he is asked to raise arm to same point. Thus his muscular sense is scientifically recorded



In this concentration test the student watches guide light and must hold his head still regardless of distractions. Headgear registers slightest movement

AT THE University of Illinois, experts in a pioneer psychological laboratory are seeking a new "Red" Grange by means of flashing colored lights, whirling electrically-connected disks, and reels of super-speed film.

The successor to the famous "Galloping Ghost" of the Illinois football teams of a few seasons ago will be picked from gridiron candidates who run the gauntlet of strange electrical testing machines that rate their muscular coördination, nerve control, and mental alertness. Even before the athletes don their cleated shoes and leather helmets for the first scrimmage, the coaches thus know the rating of each in the qualities which make for stellar performance in the heat of pigskin battles.

Electrified gameboards, covered with rows of tiny lights like those on Christmas trees, duplicate in running flashes various football plays. The candidate records what he would do at each crisis in the play while judges note the time he takes to decide and the correctness of his decisions.

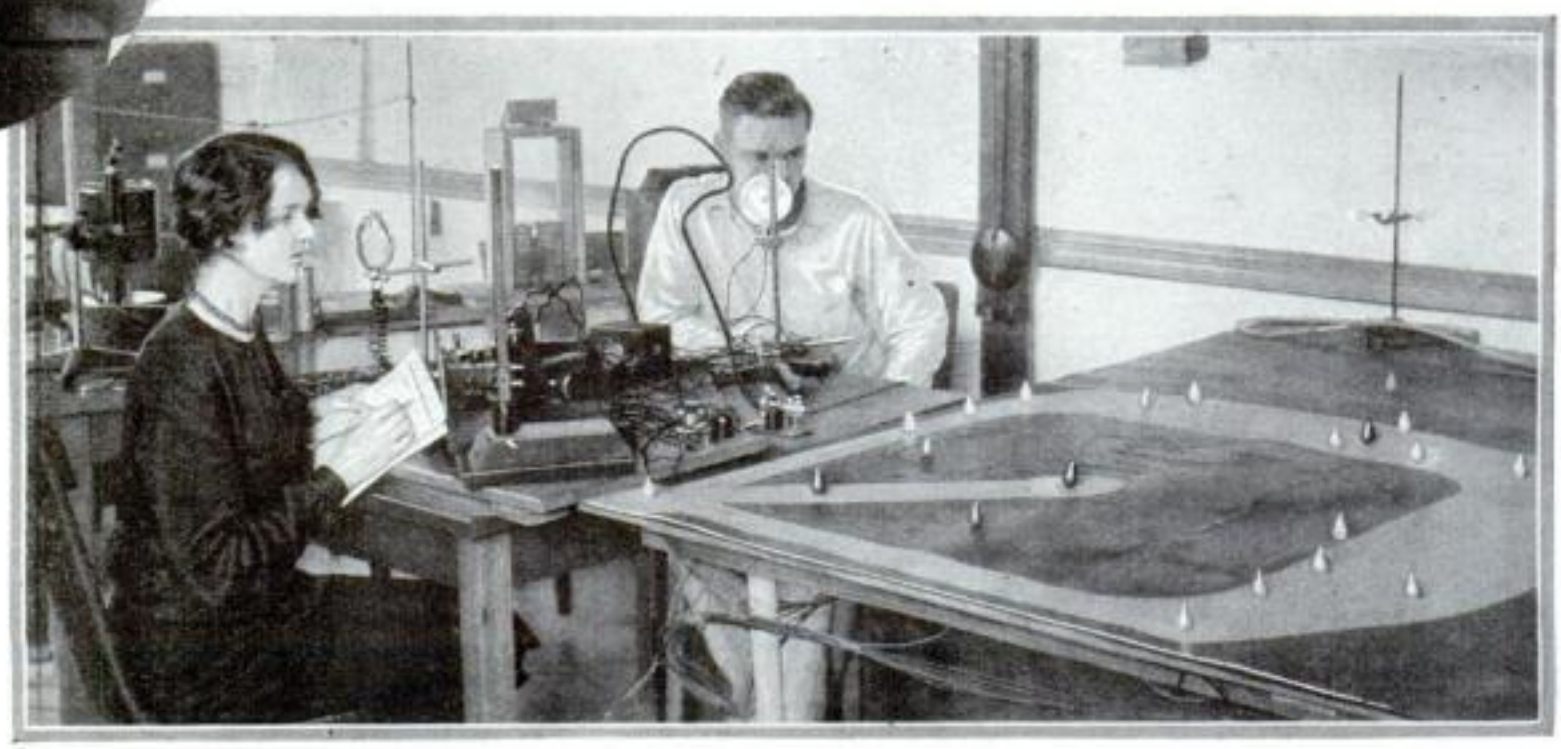
But the work in this laboratory is not confined to looking for gridiron aces. It will seek stars for the baseball diamond, the cinder track, and the basketball court.

In one of the baseball tests, forty-two plays are reproduced on a miniature field where Lilliputian lights of two colors represent the opposing nines. They flash on and off, duplicate triple plays and sacrifice hits, and give candidates tests in quick thinking.

"Timing" ability, so important in golf, tennis, and boxing, is tested in the laboratory with a strange slotted maze. Through it, each candidate moves copper pencils in a series of starts and stops. Each time the pencil touches the side of the slot an electrical connection makes a record.

Movie cameras, taking pictures at high speed, form another important part of the laboratory equipment.

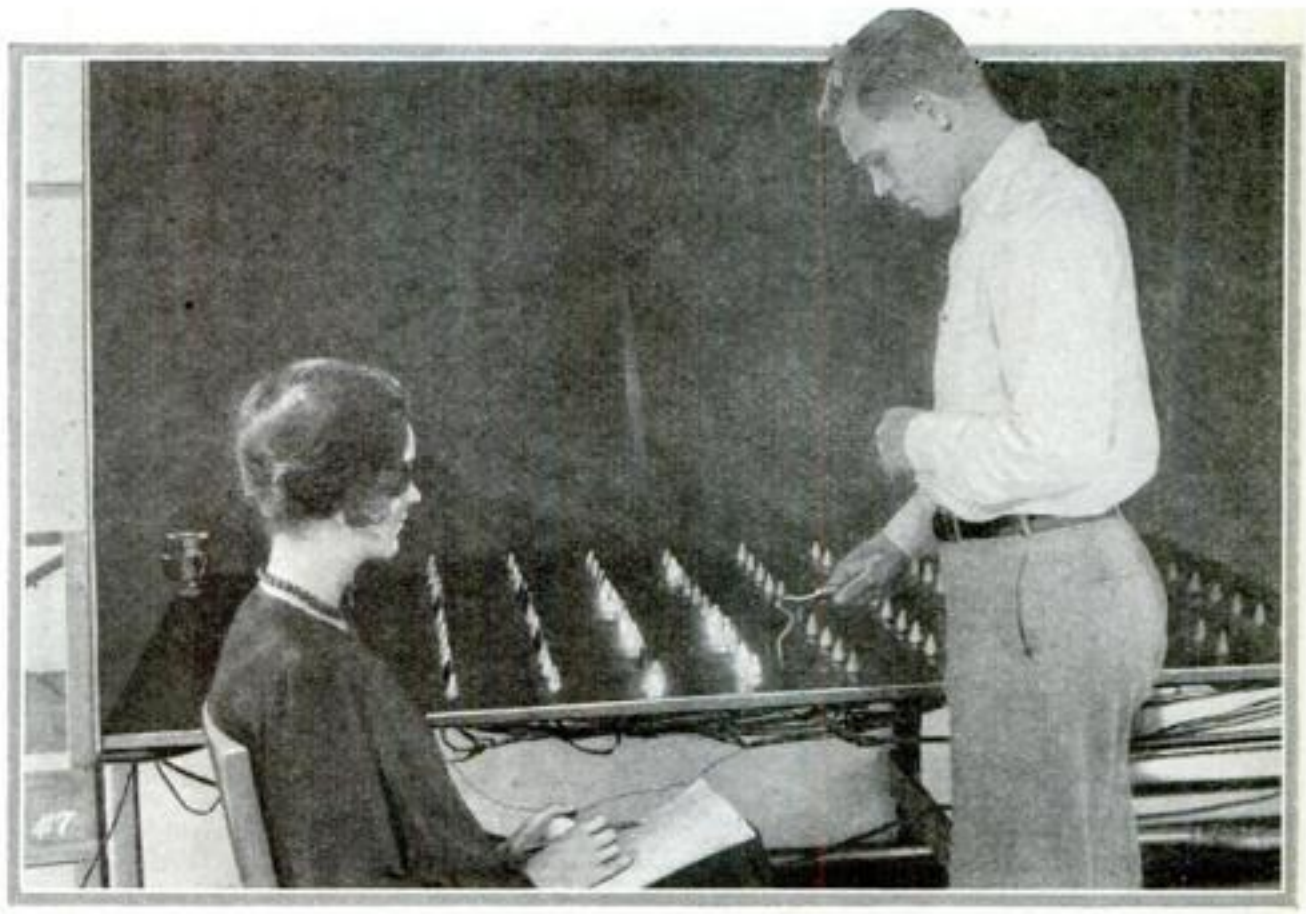
The performance of the "electrical scouts" of the Illinois laboratory in picking stars from likely material is being closely watched. If successful, this latest application of science to athletics will be rapidly adopted by other institutions.

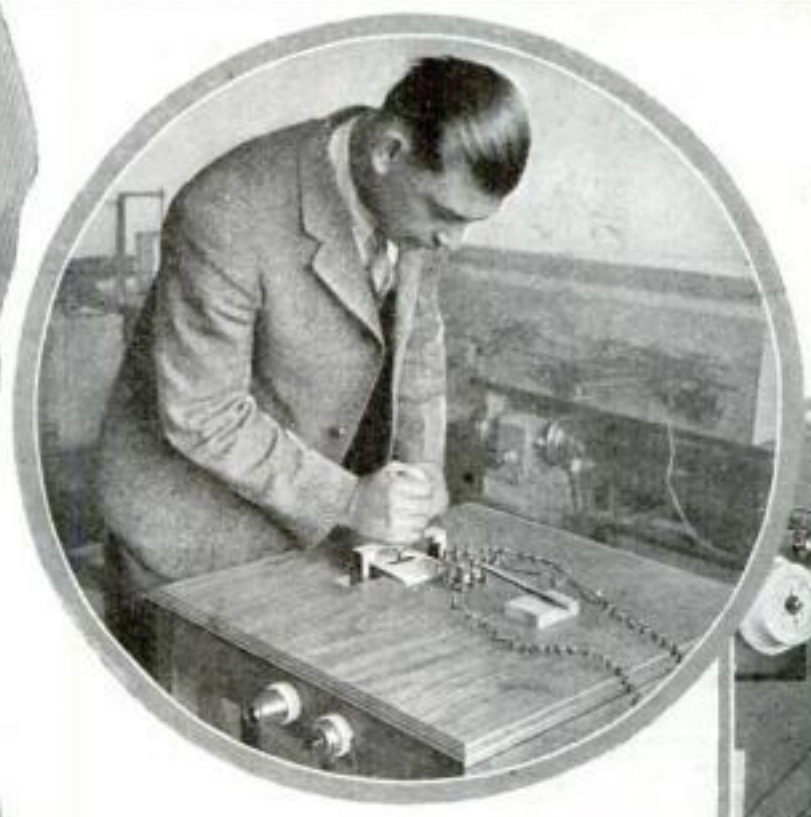


At right, electrified baseball diamond with lights as players. Student is required to solve instantly plays as flashed on board

GRANGE *by Electric Tests*

Big University's Use of Laboratory to Pick Athletes by Scientific Method Stirs Interest of All Sports Coaches

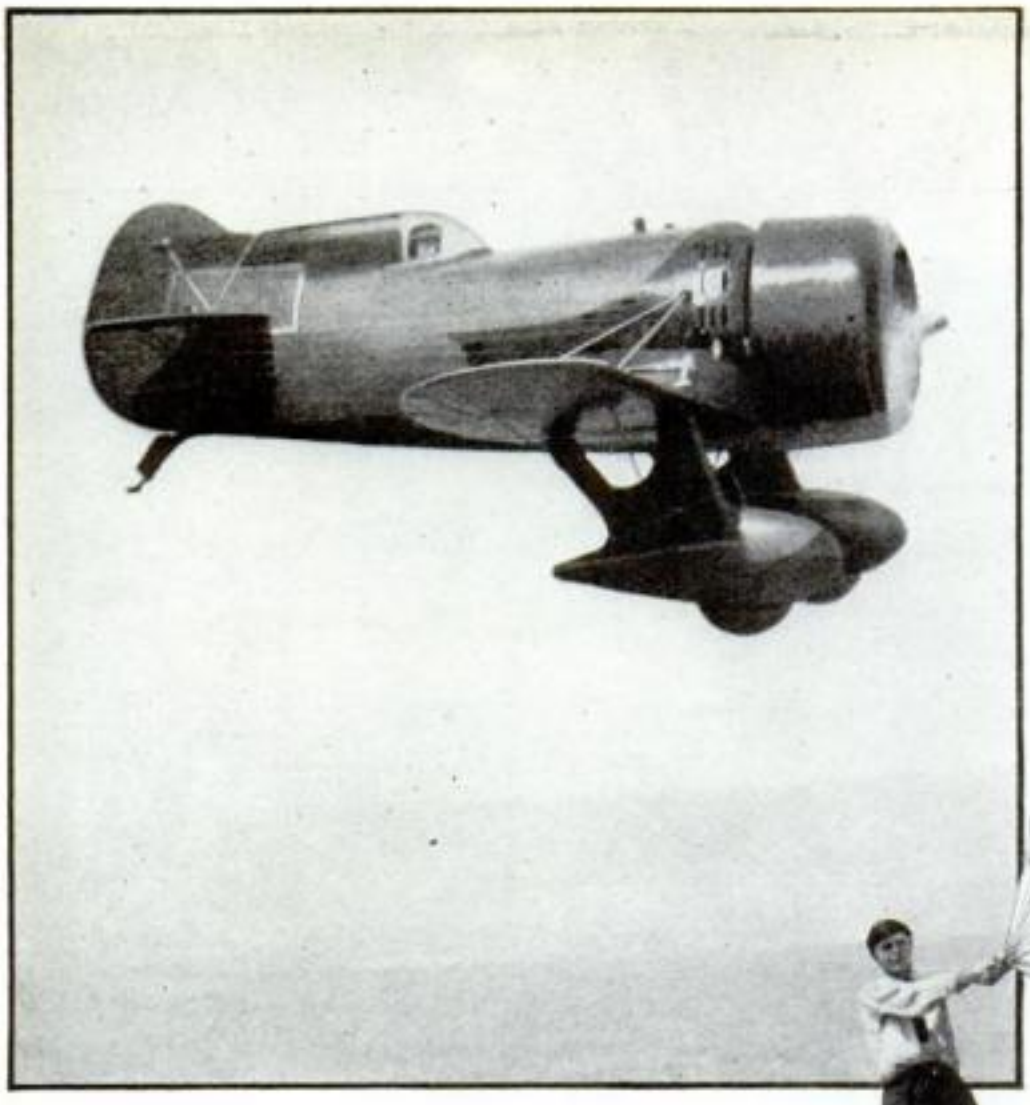




Above, an electric football field with lights as players. Student is asked to solve plays as they appear before him. This grades his mental alertness. At left, muscular dexterity is tested by means of two magnets set on a table. Athlete is told to hold the handle in a fixed position while the magnets are used to pull the handle this way and that

Eye and hand coördination are tested by means of the whirling disk shown above. On it are nine copper contact points which the student tries to touch in quick succession with electric pencil. Recording dials register all hits and misses

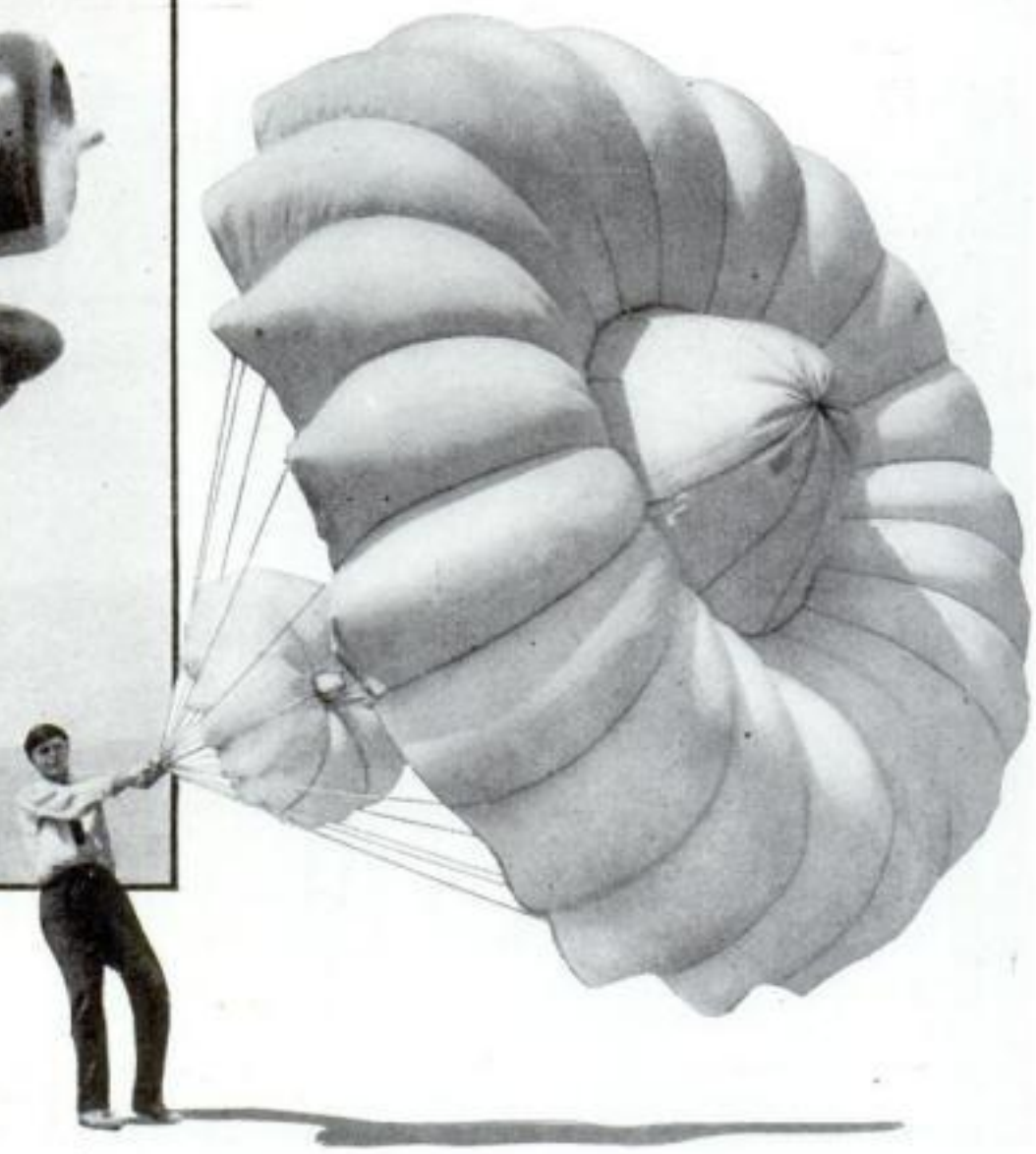
At left, making a movie of a basketball player to ascertain exactly how he comports himself on the court. The film seen on the screen at slow speed shows what the player does wrong and how to correct it



SAWED-OFF AIRPLANE GOES 275 MILES AN HOUR

EASY to time in a race is this sawed-off plane, for its nose and tail pass a marker pylon at practically the same moment. The unusual craft, going almost the limit in stubbiness of design, attained a speed of 275 miles an hour in preliminary tests. It was built primarily as a racer. How far streamlining to reduce wind resistance has affected its design may be seen in the bulletlike lines of the fuselage, the huge cowling over the motor, and the elongated and tapered fairing which covers the landing gear. This, its designer says, largely accounts for the speed the plane makes.

NEW TWO-IN-ONE 'CHUTE SMALLER AND LIGHTER

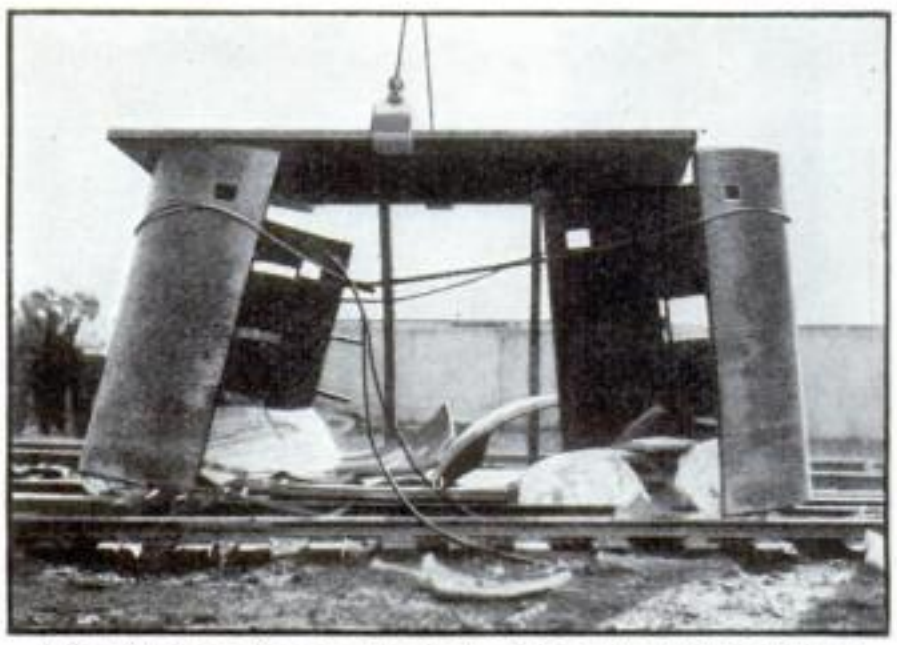


LIKE a sunflower in shape is a new parachute invented by an Alhambra, Calif., well-digger. Because of its peculiar bulbous design, it is half the usual size and weight. The small diameter—fifteen feet for the upper chute and five feet for the small chute below it—eliminates drift and relieves a jumper from the caprices of the wind. When a jump is made, the smaller chute opens first and throws open the shrouds of the larger one in the proper position so that they cannot become tangled. Tests made with dummies showed that the parachute opened within the first few feet of drop. Another advantage, according to the inventor, is that the novel 'chute has little drag after landing, while the jumper is attempting to free himself from it in a breeze, a condition that has handicapped flyers in the past.

Explode Metal Ball to Test It As Helium Container

HELIUM gas to fill airships, hitherto shipped in cylinders, may now be transported in metal spheres. Enormous quantities of the compressed gas can be squeezed into one of the balls without danger of breaking, as a recent test by a Milwaukee, Wis., manufacturer showed. In this experiment, one of the eight-foot spheres was deliberately blown to pieces to find how much pressure it would stand. Heavy steel guards were placed around the ball, behind which Naval officers and other Government representatives stood for safety. Then gas was pumped in until the ball exploded. It burst at a pressure of 5,700 pounds to the square inch, far above the pressures in commercial use. Moreover, the welded vessel performed this feat after it had already been subjected to more than thirty million blows from powerful air hammers, and a one-ton weight had been dropped upon it from a height of more than twenty feet.

Helium gas for airships may be transported in metal spheres like the eight-foot one above



One of these spheres, under test with helium, burst at 5,700 pounds to square inch. Note steel guards that protected watchers

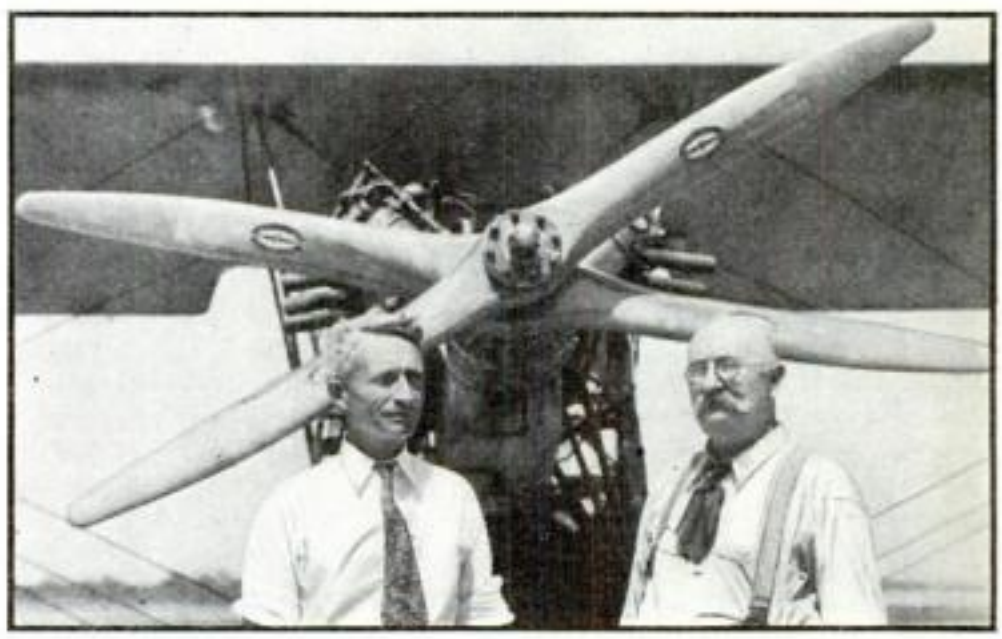
Flyer Takes Movie of Self in Air

At right, Assen Jordanoff in plane equipped with automatic camera to take moving pictures while in air. Above, camera that photographs ground during maneuvers

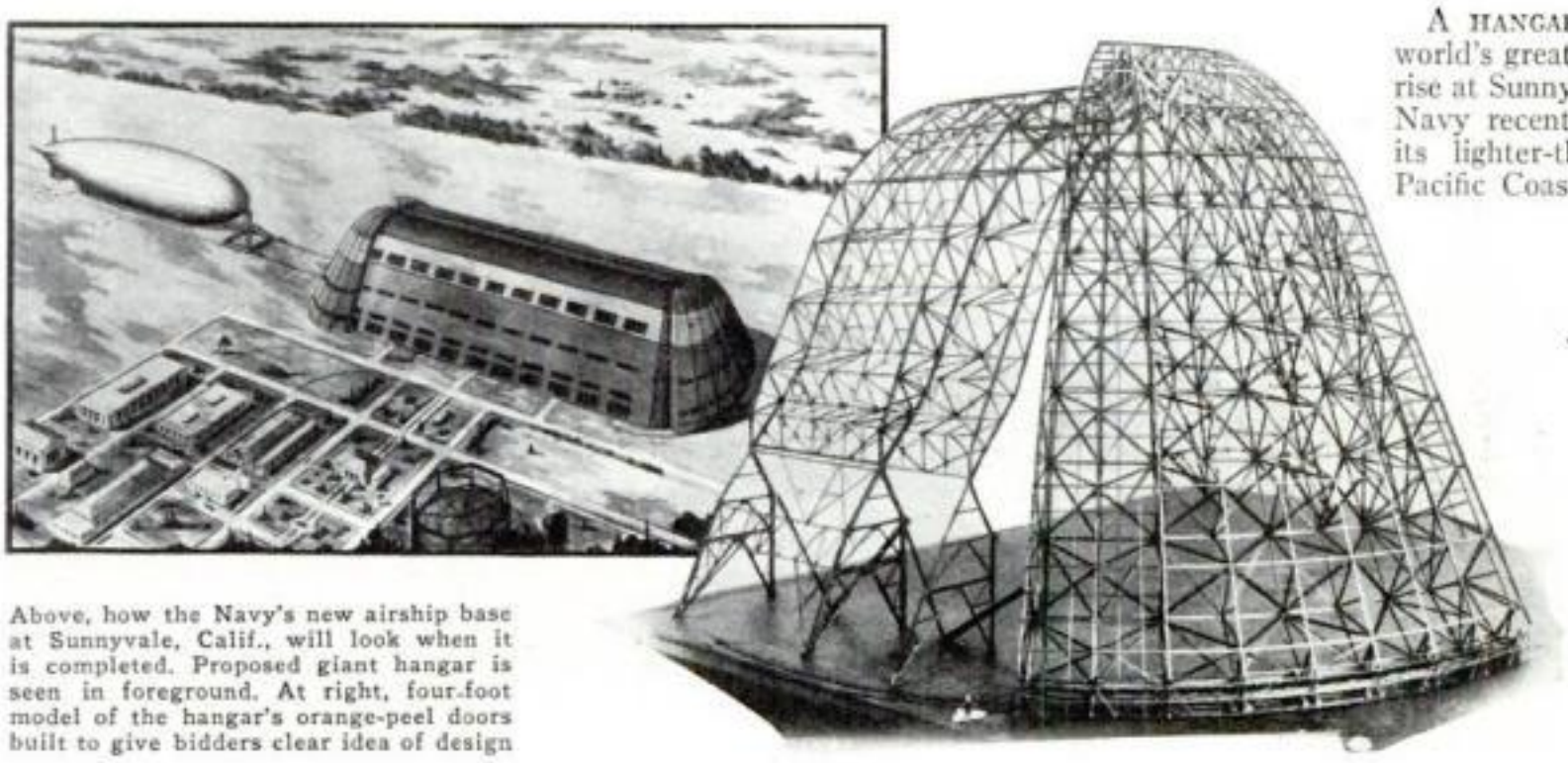
IN THE making of a recent film showing how students learn to fly, Assen Jordanoff, noted aviator and author of a number of articles on flying that have appeared in POPULAR SCIENCE MONTHLY, took movies of himself. An automatic movie camera, run by batteries, was mounted in the rear cockpit of a dual control plane. At the start of a loop or a spiral, Jordanoff, in the front cockpit, pressed a button held in his left hand that started the camera. The resulting film showed just what a student in the rear would see—the instructor's movements and clouds and earth gyrating past. Subsequently a special series of pictures was made in another plane, with Jordanoff piloting in the rear cockpit while a cameraman in front of him obtained views of upsrushing fields and trees during a steep dive. For these pictures the rear of the propeller was painted a dull black, so that it would not reflect sunlight into the lens of the camera. Additional reels showed the student pilot each step in the process of learning to fly an airplane.

PLANE'S PROPELLERS REVOLVE IN OPPOSITE DIRECTIONS

TWIN propellers, revolving in opposite directions, successfully drove an airplane in a recent test at Fort Worth, Texas. According to the inventors, M. M. Egan and D. W. Evans, it may make possible hitherto unattained airplane speeds. Vibration is said to be eliminated by the novel combination, lessening the likelihood of airsickness. Another advantage is the banishing of "torque," which causes a plane to tend to lean sideways from the force of its single propeller's whirling. In the new drive, the front screw is mounted in the conventional way upon the main shaft of the engine. Behind it the second propeller whirls in the opposite direction, half again as fast as the first. According to Brig. Gen. B. D. Foulois, Chief of the Army Air Corps, the device is interesting because propellers have changed little and new designs, he believes, are desirable.



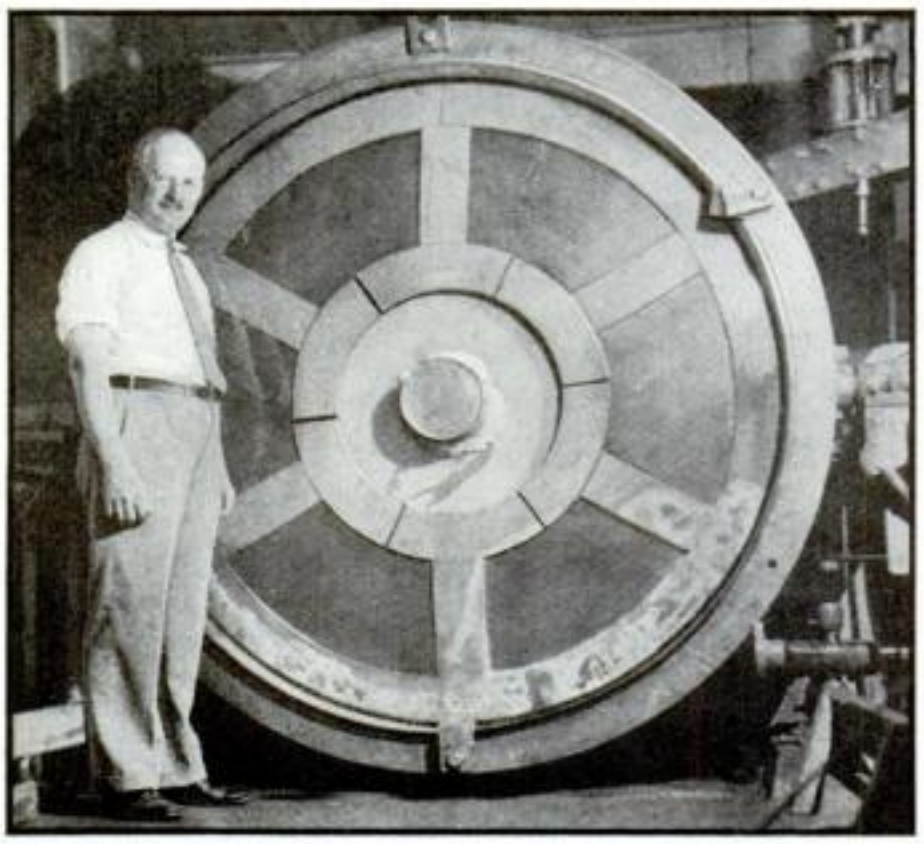
Doors for Biggest Airship Hangar Built in Tiny Model



Above, how the Navy's new airship base at Sunnyvale, Calif., will look when it is completed. Proposed giant hangar is seen in foreground. At right, four-foot model of the hangar's orange-peel doors built to give bidders clear idea of design

A HANGAR that can house the world's greatest airships is soon to rise at Sunnyvale, Calif., where the Navy recently selected a site for its lighter-than-air base on the Pacific Coast. To help explain to bidders the intricate construction of the hangar's huge curved doors, hard to illustrate on paper, the brass model shown in the photograph immediately to the left was built exactly to scale. It stands four feet high. Barely discernible at the bottom of the photo, a tiny figure of a man, also to scale, shows the immensity of the structure.

GIANT MIRROR BRINGS STARS NEARER



J. S. Fecker, Pittsburgh, who put finishing touches on new mirror

SUCCESSFULLY cast, ground and mounted after years of the most delicate labor, the largest telescope mirror ever made in the United States brings the stars nearer in a huge reflecting telescope at the Perkins Observatory of Ohio Wesleyan University. The sixty-nine-inch disk makes that telescope the third most powerful in the world. Completion of the mirror is a triumph for American optical workers, since formerly all big telescope mirrors were made abroad and transported here at great risk.

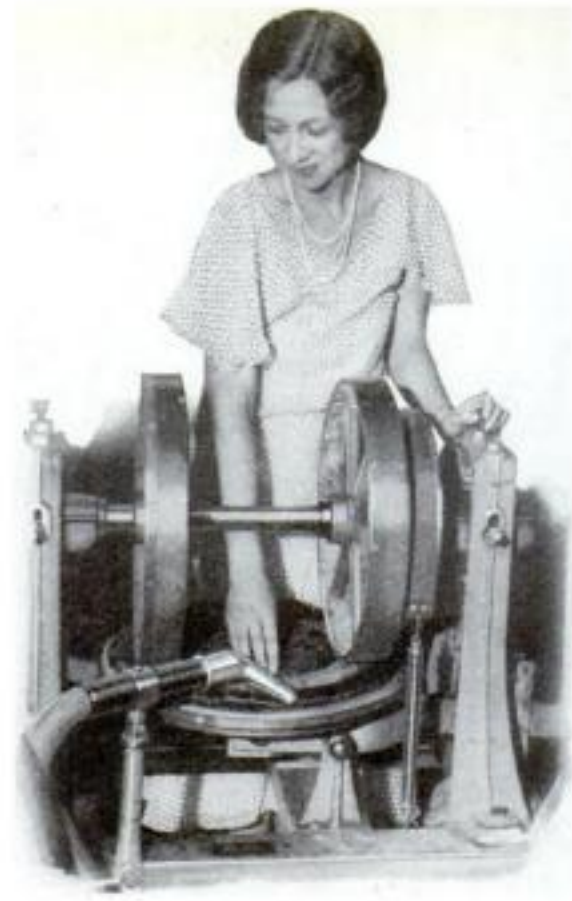
HEAVY CURRENT MAKES ELECTRIC CABLE KICK

THAT an electric cable squirms and kicks like a high-pressure fire hose, if a heavy enough current runs through it, was demonstrated the other day in the Westinghouse high power testing laboratory at East Pittsburgh, Pa. When 200,000 amperes of electricity, one of the largest testing currents ever produced, was shot through the cable photographed above, it writhed so forcefully that it burst half-inch lashings of rope and broke a solid eight-inch porcelain support. The photograph above shows the frayed marks of the cable's contortions.

TELEGRAPH OPERATOR BUILDS LOCOMOTIVE

A RAILROAD telegrapher with a hobby for model-making constructed the ton-and-a-half locomotive pictured at the right with its builder standing near it. It is patterned after a Southern Railway engine. Driven by a four-cylinder gasoline engine, it hauls twenty passengers along a section of real track. The unusual locomotive has three speeds forward and one in reverse, and is capable of making forty-five miles an hour. Material to build it came from lumber and junk yards.

Champion pocketknife whittler, C. L. Goodwin of Clarksville, Ark., has a hobby for making canes bearing strange decorations

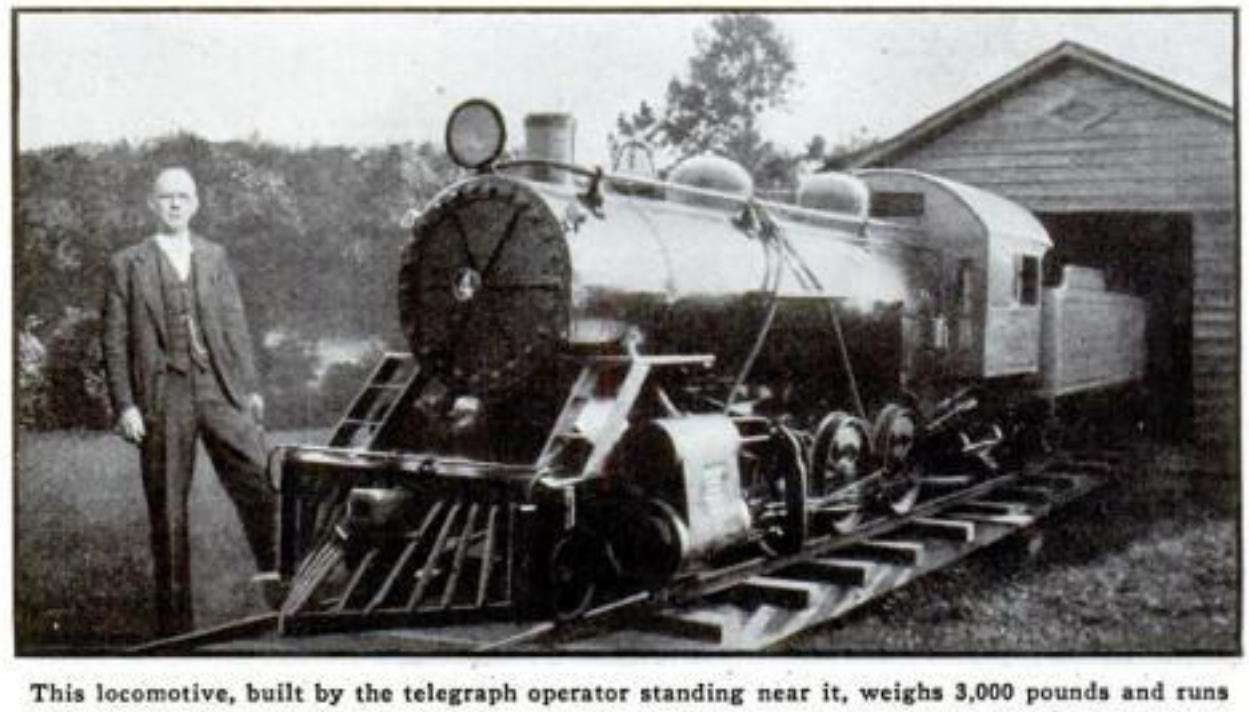


ROLLERS WEAR CARPET TO TEST MATERIAL

A MACHINE used to test carpets, at the U. S. Bureau of Standards, gives them as much wear in a few minutes as they would get in the entire course of their normal life. Tacked to a turntable, a circular sample is revolved beneath the pressure of two leather-covered rollers that simulate scuffing feet. Material worn off is removed by a vacuum cleaner. In the photograph above, the worn ring produced by the friction of the rollers is clearly seen. With the aid of this device the durability of different materials may be compared.

POCKETKNIFE WHITTLER MAKES WALKING STICKS

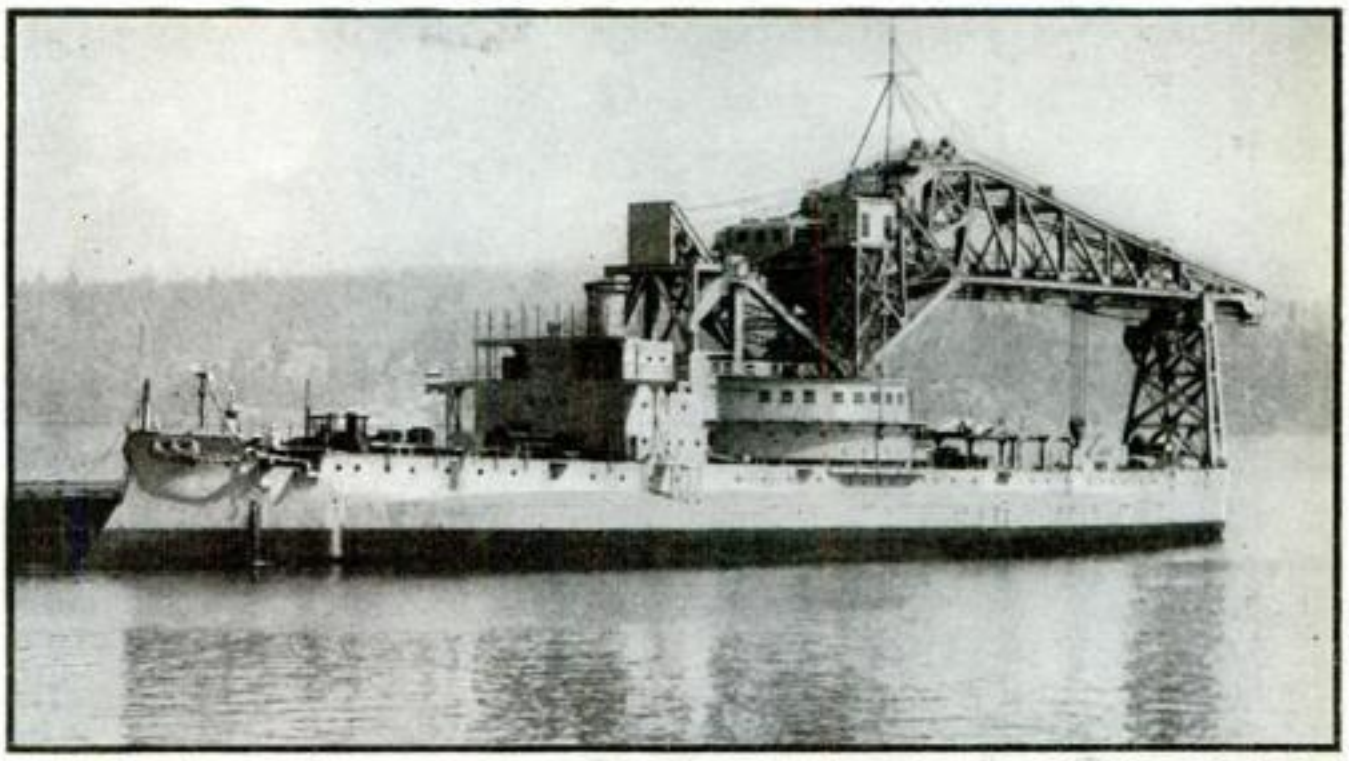
MAKING unusual walking sticks is the hobby of C. L. Goodwin, champion whittler of Clarksville, Ark. His only tools are a pair of pocketknives, and each of the sticks is carved out of a solid piece of wood. The illustration shows Goodwin with a remarkable stick he whittled from cedar. At the top, figures depict a yoke of oxen. In the middle is a pig, and a chicken occupies the bottom.



This locomotive, built by the telegraph operator standing near it, weighs 3,000 pounds and runs

Mighty Crane on Navy Ship Can Lift 250 Tons

LARGEST of its kind afloat is U. S. Navy Crane Ship No. 1. Its enormous machinery can lift 250 tons, twice the weight of an average locomotive. The unusual shape of the craft, as seen in the photograph at right, is designed to keep it from keeling over upon attempting to lift so great a weight. Floating hoists of greater capacity have been built, among them the Welland Canal lifter, which can pick up the 450-ton lock gates of that Canadian waterway (P. S. M., Mar. '31, p. 35). But that squat hulk can scarcely be called a ship, as it has no propelling machinery.



This U. S. Navy Crane Ship No.1, largest of its kind afloat, has a giant crane that can lift 250 tons at once. Its odd shape keeps it from keeling over when the crane works

COPPERIZED PAPER MAY SAVE STORAGE FRUIT

THOUSANDS of dollars may be saved annually for pear growers of Oregon and Washington by the use of copperized paper, a discovery of the U. S. Department of Agriculture. Used to wrap pears in storage while they are awaiting shipment to the consumer, it prevents the spread of "gray mold," a troublesome and costly type of decay. Ordinary paper wrappers are impregnated with a liquid copper solution developed for the purpose by the plant pathology bureau of the Department of Agriculture. The girl in the picture is holding a flask of this solution and a sample of the copperized paper.

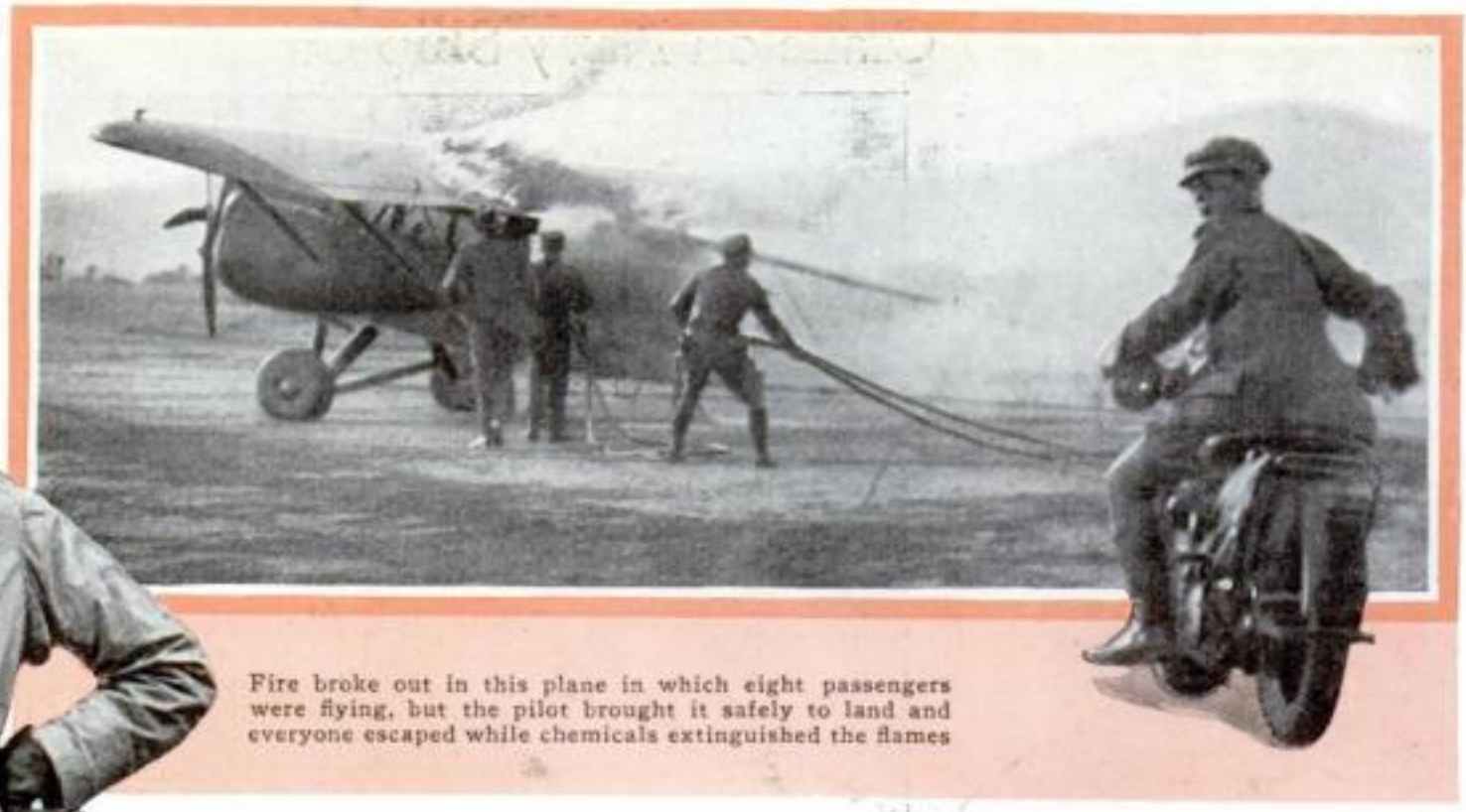
BUILDS HIS OWN EARTH AND STARS

MAGNETS operate a homemade planetarium that Clement Engel, New York City amateur astronomer, has built for himself, and which, he says, any enthusiast may duplicate at small expense. It illustrates in simple and understandable fashion the relation of the earth to the stars and planets in space. A small globe, representing the earth, is mounted on a bow-shaped float that turns freely in a pot of water. Magnetized rods keep its axis pointed toward the North Star. Holding the pot in his hands and walking in a circle, an experimenter may demonstrate how the earth maintains its axis in the same direction during its orbit around the sun. Engel places this device beside another of his inventions, a magnet-swung umbrella with the position of the stars marked upon it, and his planetarium is complete.

RADIO ROBOT FOR SHIP CAN'T MISS SOS CALL

SEAGOING radio operators may now go to their meals or retire for the night, regardless of heavy weather, without fear of missing a call from a ship in distress. The newest vessels that ply the Pacific are equipped with an automatic SOS alarm system, and one of them, the liner *Seattle*, already has heard its alarm bells operate. When the radio operator leaves his station he cuts in a connecting switch and the device keeps watch for him. It is tuned to the customary radio channel of 600 meters. If an SOS comes in, the automatic receiver picks it up through a complex filter system and causes three gongs to sound—one in the wireless cabin, one in the chief operator's room, and a third on the bridge where an officer is always on watch. The gongs continue to sound until the operator reaches his set, cuts off the alarm, and listens for the call from some ship in distress, as shown in the photograph above.

Below, Captain Frank T. Courtney, dressed for the take-off of his attempted flight west over Atlantic



Fire broke out in this plane in which eight passengers were flying, but the pilot brought it safely to land and everyone escaped while chemicals extinguished the flames

Captain Frank T. Courtney, *who escaped from a burning plane in mid-Atlantic, describes his thrilling moments when . . .*

Fighting FIRES

I WAS nine thousand feet over the Western Front when I met my strangest adventure with fire in the air. A German Albatros artillery plane was sighted cruising back and forth over the lines directing the fire of the big guns north of Armentiers. With two other British pilots, I was detailed to attack. Taking a new observer, just up from training camp, I hopped off in a fast "one-and-a-half-strutter" Sopwith. The other pilots couldn't get their frozen motors going. I started on alone.

Coming out of the clouds a thousand feet above the Albatros, I dove and opened fire. My machine gun fired one shot and jammed. I shouted through the speaking tube for the observer to swing around his gun and shoot. Nothing happened. Wired to the struts above the windshield, I had a little round shaving mirror to give a rear view. In it, I caught a glimpse of the rookie, paralyzed with fright. Slapping on the throttle, I zigzagged off, trying to fix the gun. It was in a "number three," the worst kind of a jam, and my hands were cold. Just as I gave it up, a black enemy pursuit plane burst into view coming at terrific speed from our side of the lines.

I shouted and waved my arm but the observer sat rigid as a post. Each second, I expected to hear the whine of streaking bullets. Then a miracle happened. The roar of the black plane's engine rose to a shriek; the Maltese-crossed wings flashed past less than 200 feet overhead, and the machine rocketed away toward the German lines. The only explanation I could ever offer was that the pilot didn't see us or that he was out of ammunition and was racing home at top speed.

By this time, the Albatros had swung around in the distance and headed towards me. Below, I could see another Sopwith climbing toward us. One of the pilots had got his motor going. I called through the tube for the observer to fire a red Very light so the approaching plane would race to the attack. I glanced in the mirror to see what would happen. At that instant, an immense cloud of swirling white smoke burst from the rear cockpit. The shaking observer, in pulling the Very pistol from its holster, had accidentally fired the two-inch ball of blazing phosphorus into the cockpit at his feet!

I CUT the motor and dove headlong for the ground. My one thought was to get down before the intense heat of the burning ball melted open the big gas tank against which it almost rested. All the way down, I could see in the mirror the observer's head pop above the windshield and then disappear in the cockpit in regular rhythm. Inside, the smoke almost suffocated him; outside, the gale nearly blew his head off.

WE SAT down in a fast landing and rolled nearly to the hangars, where the mechanics saved the plane by speedy work with chemical fire extinguishers. The observer was not seriously burned but was literally stiff with fear. He was rejected from the R. F. C. and, strangely enough, he later became a hero on the ground. Transferred to the infantry, he was decorated a few months later for bravery in the trenches.

Ordinarily, the last thing a pilot should do in case of fire on a tractor plane, having the engine at the nose, is to dive. The flames usually start around the motor. A dive blows them back over the fuselage. Instead, the flyer kicks the ship into a steep side slip, blowing the flames to one side. In a pusher plane, with motor at the rear, a dive is the correct maneuver, blowing the fire to the rear, away from the wings and body.

The instant a fire breaks out in the air, the pilot should do three things. First, cut off the gasoline going to the carburetor to keep from adding fuel to the flames. Second, slap on the throttle, using up the gas already in the carburetor as soon as possible. And, third, dive steeply, if in a pusher, or side-slip, if in a tractor, to pre-

FLAMES Were, at One Time, the Worst Hazard Met by Flyers. This Story Tells Why That Was So and How Planes Are Now Built to Head Off Fire

High *in the* AIR

vent the fire from reaching the wings and fuselage.

Almost all disastrous airplane fires have resulted from the failure of the pilot to cut off the fuel the instant the fire began. Recently, a seaplane flying in the East caught fire in the air. The pilot landed on the water and taxied to shore where the ship burned up completely, probably because he was unable to cut the gas and the high-test fuel kept pouring on the flames.

Designers are soon going to incorporate a master fuel cut-off so that all the fuel flow in a multimotored plane can be stopped with a single movement of the hand, just as an emergency ignition switch is now provided.

PRACTICALLY all fires begin in the fuel system back of the motor. Yet, in one queer case, I had it begin ahead of the engine. My propeller began to burn while I was traveling a hundred miles an hour!

A light plane race was being held at Lympne, a large customs station on the British coast near Folkestone. I entered a Parnell "Pixie II," a mothlike monoplane with an eighteen-foot wing span and a tiny six-horsepower motorcycle motor. At top speed, the midget motor whirled its little four-foot propeller at something like 3,600 revolutions a minute. My mechanic nicknamed the diminutive machine "the Infuriated Grasshopper."

Practicing for the race, I was clipping the treetops at full throttle when I smelled burning wood. As the nose of the plane was constructed of metal, I thought a farmer below must be burning brush. I looked over the side of the fuselage. Bing! Something black—the propeller—streaked past my right ear. The little engine screamed.

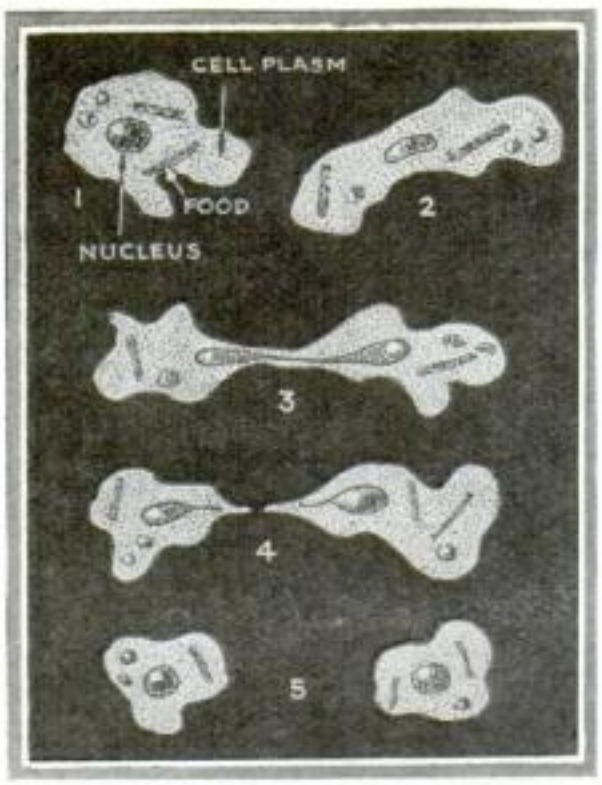
I CUT everything and headed for a plowed field. I just made it. The wheels of the landing gear struck the top wire of the boundary fence, leaving two depressed points that gave it the appearance of a wide-spread letter W, then bounded over into the soft plowed ground beyond.

What had happened was this: The hub bolts of the propeller had worked loose

(Continued on page 128)

When Courtney Fought Fire in Mid-Atlantic

Downed by flames when halfway across the Atlantic, radio called ships to the rescue of Captain Courtney and his associates. At top, photo taken by Courtney as rescue ship approached. Center picture shows flyers on board the rescuing *Minnewaska*. At right, the *Valprato*, which salvaged Courtney's plane and brought it in to land



At left, illustration shows how amoeba reproduces. The cell contracts into the form of a dumbbell and eventually splits in two even parts each with a nucleus

Secrets of EX*plained by* SCIENCE

What Has Been Told of Man's History

IN THE five preceding talks of this series, Dr. William K. Gregory, of the American Museum of Natural History, has told how the earth, life, and man originated. He began by explaining how the earth was torn out of the sun and how life first appeared as specks of jelly in mud and puddles. Dr. Gregory has told how man got his face from a shark, and traced his descent from apelike forebears. This month the story is taken up by Dr. Herbert Ruckes, noted member of the Biological Faculty of the College of the City of New York, and secretary of the New York Academy of Sciences. In this talk, Dr. Ruckes tells how man perpetuates himself and how heredity works.

MR. MOK: Dr. Ruckes, in my last talk with Dr. Gregory, I asked him how it was possible that we had inherited physical and mental traits from ancestors who lived thousands of years ago. That, he said, was the story of inheritance, and he suggested you as the man to tell me that story.

DR. RUCKES: It was kind of Dr. Gregory to think of me. I shall be glad to tell you what I know of the subject.

MR. MOK: Fine. Will you please explain, then, what is meant by inheritance? Why are some people white and others yellow or black? Why is it that some of us have inherited tall statures, long faces, blond hair and fair complexions and others stocky figures, round heads, dark hair and olive skins? Or, to bring the question up to date—why have I brown eyes, like my parents?

DR. RUCKES: I am afraid you are going a bit too fast. Let me begin by answering your first question, and the rest will come as we go further into the matter. Inheritance is the ability of any organism to transmit its characteristics to its offspring.

MR. MOK: I suspected as much. But *how* does it happen?

DR. RUCKES: Chiefly, in two ways: either by a vegetative process known as asexual, or sexless, reproduction, or by a more elaborate process known as the sexual method. Sexless reproduction is the first, the original method of procreation. It has nothing whatever to do with what we know as sex. Primarily, it is a process of cell division, or cell fragmentation, which is easily illustrated by the case of the amoeba, the one-celled water creature that is still with us.

MR. MOK: The amoeba is an old friend of mine. But I did not expect to meet it so soon again. I thought you were going to tell me how human beings pass on their characteristics.

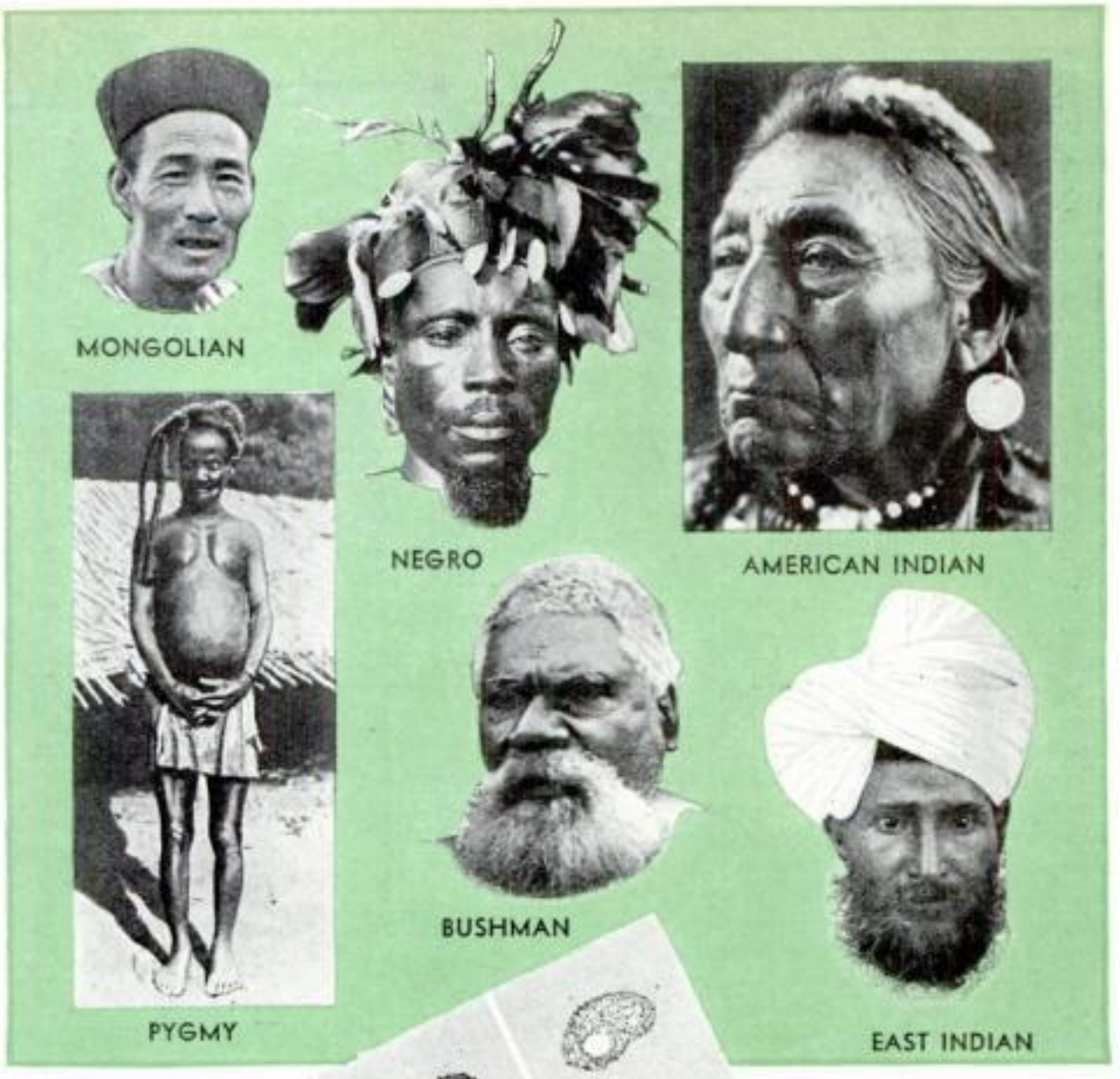
DR. RUCKES: I am, but to give you a clear understanding of the workings of reproduction and inheritance, it is necessary for me to tell you the story from the beginning. Since you are acquainted with the amoeba, you know that it is a tiny blob of transparent, jellylike, living material called protoplasm. Now, the amoeba produces its offspring in this way: First, it rounds itself up. Then, by assuming a

FAMILY TRAITS ARE INHERITED

At left, father and mother and their eleven sons. The strong family resemblance indicates physical characteristics are inherited. At top, note striking resemblance between the mother and daughter

MYSTERIOUS Laws of Inheritance Keep the Races of the World Distinct if There Is No Cross-breeding. The Pictures at Right Show How the Main Features of Each Race are Preserved by Heredity from Father to Son

• •



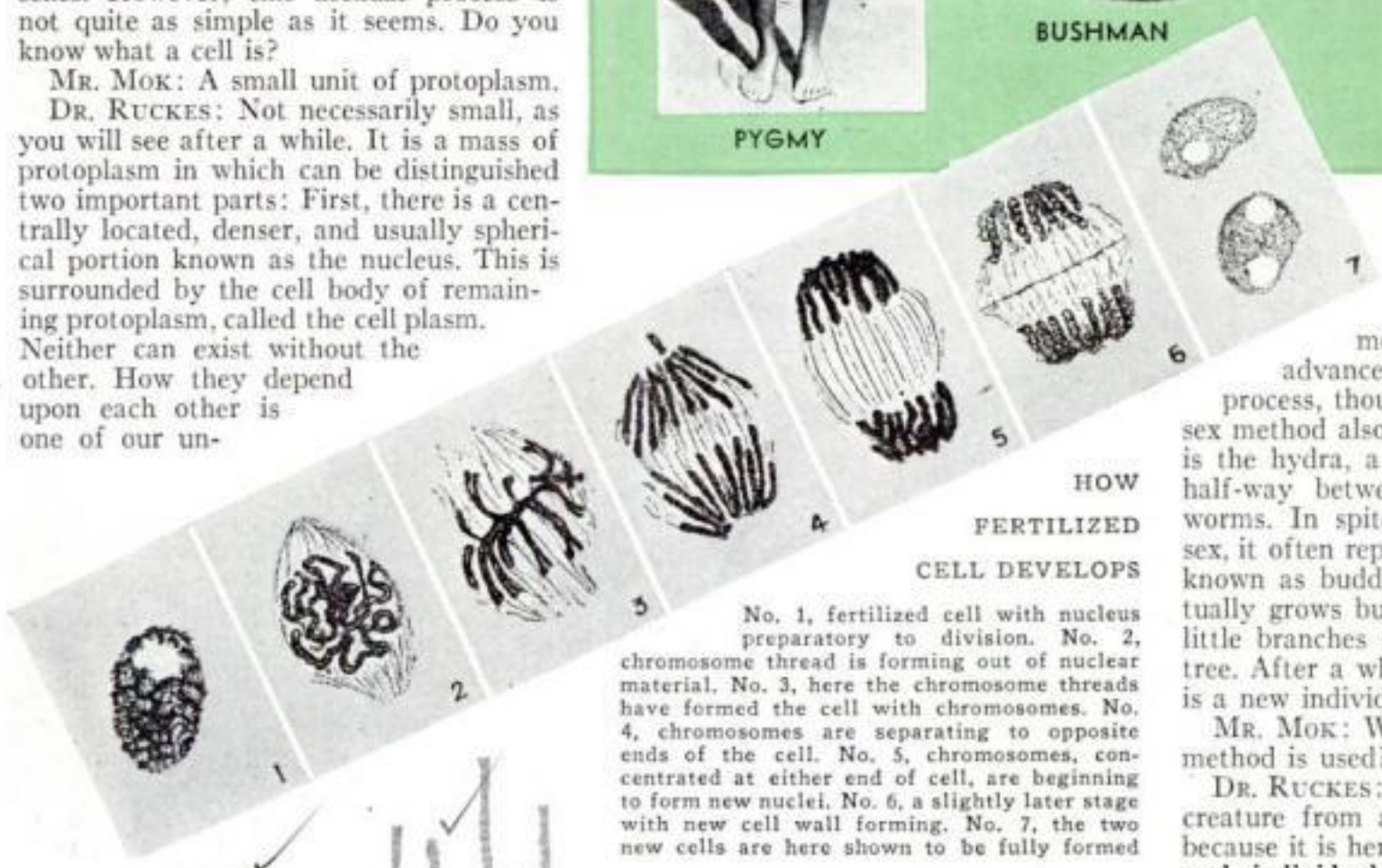
dumbbell shape, it gradually pulls itself apart to form two daughter animals.

MR. MOK: I thought they were sexless?

DR. RUCKES: So they are. "Daughter animals" is the expression used to signify that the new individuals are again future mothers. Though these primitive creatures have no sex at all, they are, in a sense, female, simply because they give birth to others. From that point of view, the female is by far the older of the two sexes. However, this asexual process is not quite as simple as it seems. Do you know what a cell is?

MR. MOK: A small unit of protoplasm.

DR. RUCKES: Not necessarily small, as you will see after a while. It is a mass of protoplasm in which can be distinguished two important parts: First, there is a centrally located, denser, and usually spherical portion known as the nucleus. This is surrounded by the cell body of remaining protoplasm, called the cell plasm. Neither can exist without the other. How they depend upon each other is one of our unsolved riddles, but the fact remains that, if you take either away, the other dies. The nucleus is the central, working part—the heart of the future creature. When the amoeba which, remember, consists of only one cell, divides, not only the cell plasm falls into two parts, but the nucleus also is about evenly divided.



HOW FERTILIZED CELL DEVELOPS

No. 1, fertilized cell with nucleus preparatory to division. No. 2, chromosome thread is forming out of nuclear material. No. 3, here the chromosome threads have formed the cell with chromosomes. No. 4, chromosomes are separating to opposite ends of the cell. No. 5, chromosomes, concentrated at either end of cell, are beginning to form new nuclei. No. 6, a slightly later stage with new cell wall forming. No. 7, the two new cells are here shown to be fully formed

MR. MOK: Is each half complete?

DR. RUCKES: Yes, except that each is much smaller than its parent which, of course, does not exist any longer. This is about the simplest form of reproduction known in the animal kingdom.

MR. MOK: Is the amoeba the only living thing that reproduces itself in this way?

DR. RUCKES: By no means. Many of the more advanced animals employ the same process, though they already have the sex method also. The commonest example is the hydra, a tiny, cylindrical creature, half-way between the amoeba and the worms. In spite of the fact that it has sex, it often reproduces itself by a process known as budding. In those cases, it actually grows buds on its sides, much like little branches growing from a miniature tree. After a while, the bud drops off and is a new individual.

MR. MOK: What happens when the sex method is used?

DR. RUCKES: The hydra is a fascinating creature from a scientific point of view, because it is hermaphroditic, meaning that each individual is both male and female. It has the ability to produce sperms, which are the male reproductive cells, and also eggs, which, as everyone knows, are the female reproductive elements. In this connection it is interesting to know that an egg, no matter how big, is always one single cell, the creature's egg cell. The ostrich egg probably is the largest single cell in existence. So, you see, a cell need not necessarily be small.

MR. MOK: Do you mean that the entire egg is one single cell, or just the yolk?

DR. RUCKES: The entire egg.

MR. MOK: Is the yolk the nucleus?

DR. RUCKES: Oh, no. The nucleus is microscopically small. It is found on the

HYDRA REPRODUCING
Above, the upper two dark objects are the male glands of the hydra and the lower large, irregular one is female gland. At right, hydra reproducing by the asexual method

A vitally interesting chapter in the **Story of LIFE... The World's Greatest Mystery**

surface of the yolk, which is food for the developing young.

MR. MOK: And what is the white of the egg?

DR. RUCKES: That, too, is food for the embryo, but of a different kind. The yolk contains the fats; the white is the albumen or protein material, used mostly for the formation of the muscles.

MR. MOK: You said that each hydra is both male and female. How does it employ its two sexes?

DR. RUCKES: In a somewhat intricate but interesting way. This creature carries its eggs on the surface of its body. There also are cells that produce sperms. The sperms are freed from the body into the fresh water in which the hydra lives. Now, a very important attribute of this sperm, and of *all sperms*, is that it can swim, while egg cells, though also alive, are always stationary. *This is true of the entire range of animals from the lowest to the highest, including ourselves.* Once in the water, the hydra sperm swims around for a while until it meets an egg cell upon the body of the very hydra that freed it or of another one. The sperm cell enters the egg cell, and when the nucleus of the sperm cell and the nucleus of the egg cell unite, or are "wed," fertilization is accomplished. That is why I laid so much stress on the importance of the nucleus which, as I told you, is the active, controlling part of the cell. *The union of sperm nucleus and egg nucleus is the fundamental principle of procreation among all animals that are male and female, from these humble water creatures below the worms all the way up to man.*

MR. MOK: As I understand it, you now have explained the two methods of reproduction—the sexless, or cell-division, process, and the sex method?

DR. RUCKES: Yes, these are the two principal ways in which animals multiply. However, there is an intermediate stage—a sex method in which there is no distinction between maleness and femaleness.

MR. MOK: How can there be sex without male and female?

DR. RUCKES: Any method of reproduction that involves the union or wedding of two cells, whether they are alike or unlike, is a sex method. In other words, in this intermediate stage, two identical cells are united to produce offspring. Though there is no male and female here, this really is the beginning of sex. It represents just one step above self-division.

MR. MOK: Is there any creature living that reproduces in this manner?

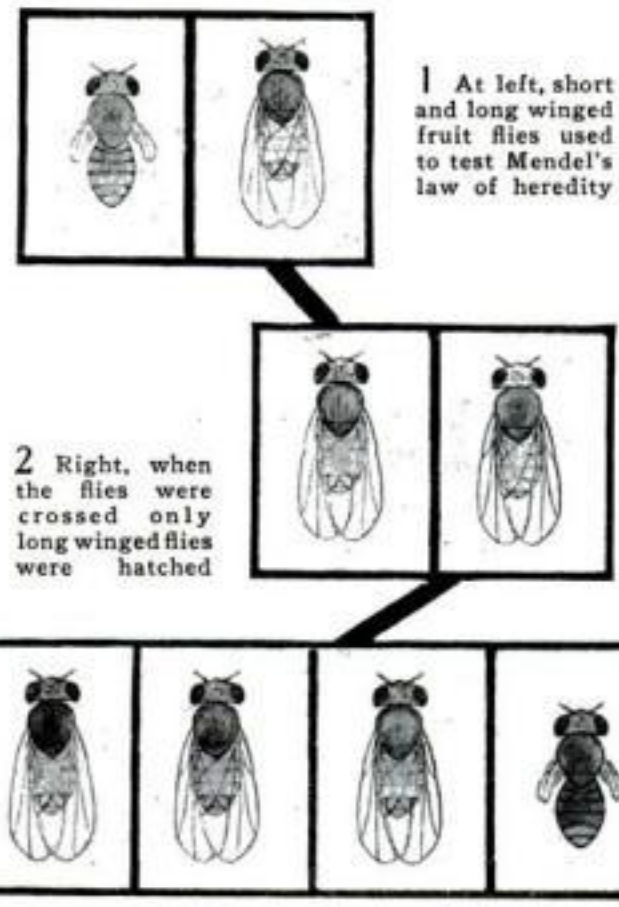
DR. RUCKES: Certainly. Among the relatives of the amoeba there is a minute, slipper-shaped, water-living creature, called *paramoecium*, that perpetuates itself in that way.

MR. MOK: A little while ago, you told me that reproduction of all higher animals, including ourselves, takes place through the union of a swimming sperm and an immobile egg. Surely, the higher animals don't lay eggs?

DR. RUCKES: I take it that, by higher animals, you mean the mammals. Of course, they don't lay eggs. But they have them just the same. They remain inside the mother's body and develop there until the young is ready to be born. Except for a few very rare egg-laying mammals, this holds good in the cases of all mammals, including man.

Abbe Gregor Johann Mendel, who discovered for the first time the real laws of inheritance

Courtesy American Museum of Natural History



1 At left, short and long winged fruit flies used to test Mendel's law of heredity

2 Right, when the flies were crossed only long winged flies were hatched

3 Breeding the long winged flies of the second generation produced three long wings and one short in accordance with Mendelian laws

MR. MOK: Do the human eggs and sperms resemble those of the other animals in any way?

DR. RUCKES: They do in every detail. The human egg cell is immobile, and has its nucleus and cell plasm. The human sperm cell, with its nucleus, is mobile, has the ability to swim, find the egg cell, enter it, and unite with it, thus causing fertilization.

MR. MOK: In the beginning of our talk, you said that the characteristics of an individual are handed down to its offspring either by this method or by cell division. Do you mean that the characteristics of human parents actually are carried by the reproductive cells?

DR. RUCKES: Yes, of human parents and all other parents. And not only that: they are carried by a vehicle even smaller than the cell as a whole, namely, by the nucleus. Tiny as this nucleus is, it in turn contains a complicated mechanism especially designed for the transmission of physical and, in the case of man, also mental characteristics. This is all the more wonderful if you consider that, in human beings, the nucleus of an egg cell or of a sperm cell is no bigger than about one one-thousandth part of one inch in diameter, meaning that approximately 2,000 of them could be accommodated on the head of a pin!

MR. MOK: What do you mean by the complicated mechanism contained in the nucleus of the sperm and egg cells?

DR. RUCKES: The nucleus consists of a substance called *chromatin*, which assumes the form of very tiny, rodlike particles known as chromosomes. These chromosomes are the actual carriers of the parental characteristics. But before we go further, let me make it emphatically clear to you that this system of chromosomes is by no means confined to man. The characteristics of *all living things*, no matter how high or how low, whether in the animal or in the plant world, are transmitted by these microscopic rods in the nucleus of the cells. That, by the way, is a striking piece of evidence for the development of life by evolution.

MR. MOK: Why?

DR. RUCKES: Because in the machinery used for these vital, fundamental operations of reproduction and inheritance, all living things show structural resemblance, as they do in so many other ways. As Dr. Gregory doubtless has explained to you, structural resemblance proves relationship and it, in turn, is evidence of common descent.

MR. MOK: What exactly have you in mind when you use the word "characteristics"?

DR. RUCKES: Simply the physical and mental features of an individual. Among a man's physical, or structural, characteristics are the color of his hair and eyes; the color and texture of the skin; the number of units in a bodily part, such as, for instance, the five fingers of his hand, and many more, too numerous to mention. As for mental characteristics, there are genius, insanity, perseverance, strength or weakness of will, courage or cowardice, and a host of others. While it is hard enough to understand that the chromosomes, these microscopic particles, are the carriers of physical characteristics, it is even more difficult to realize that they also transmit mental traits.

MR. MOK: How do you know that the chromosomes are the carriers of parental characteristics?

DR. RUCKES: We know it through actual observation and experiment. If you take an unfertilized egg cell and develop it artificially—that is to say, without the aid of a sperm—you get an embryo that shows characteristics only of the mother. Since the sperm cell consists mostly of nucleus and practically no cell plasm, it follows that the sperm nucleus transmits the father's characteristics. And since the nucleus, in turn, consists of chromosomes, it is obvious that they are the actual vehicles of the parental traits.

MR. MOK: How do you fertilize an egg artificially?

DR. RUCKES: Either by chemical or mechanical *(Continued on page 130)*

Up under the Arctic circle stands this radio station at Seward, Alaska. Through the long winter months it is all but buried beneath the great banks of snow, but its transmitter keeps on the job. At right, the station at Nome that maintains constant communication with the outside world and sends weather warnings

Messages out of the frozen north are received at Seattle and forwarded to California. Above is the Seattle operating room in which messages are being received from and sent to Ketchican

Map shows how the network of radio stations covers the great peninsula. At left, a caribou with horns entangled in telegraph wires

ALASKA, *Frozen In, Still* Talks *to* All *the* World

TO SEND a message in a hurry, a continental American files it with a telegraph or radio office, but an Alaskan goes to the Wamcats. Inhabitants give that affectionate nickname to a network of thirty-four radio stations, supplemented by telegraph lines and a deep-sea cable to the United States, known as the "Washington-Alaska Military Cable and Telegraph System." Uncle Sam owns and operates it because no commercial system has yet ventured into this frozen country.

Its adventures in maintaining service recall pioneer days. A Signal Corps operator at an outpost within the Arctic Circle was held prisoner in his shack for nine days, by a storm, before single-handed he could tunnel out beneath twenty feet of snow and repair a fallen aerial. A wandering caribou once disrupted telegraph service by entangling his horns in an overland line. Since ordinary telegraph poles would be forced out of the ground by alternate freezes and thaws, the standards are mounted on tripods whose awkward angles straddle the drifts.

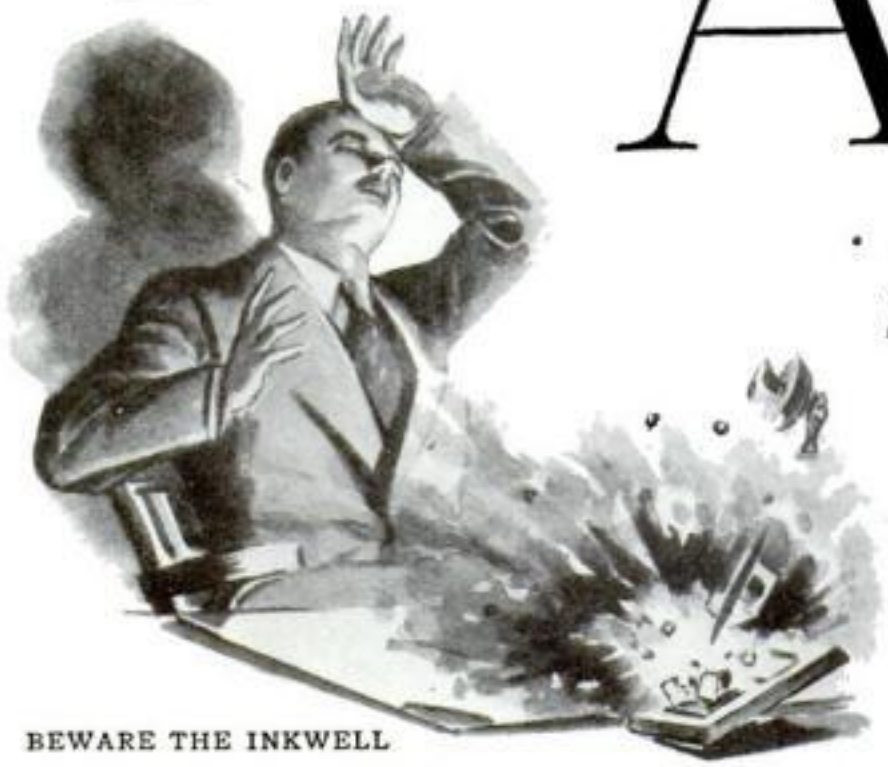
In subzero weather, the men at the Fairbanks, Alaska, radio station erect a temporary mast in place of one blown down

Besides handling private messages, which could be dispatched in no other way, the Wamcats performs priceless services. When a cold wave sweeps down from the north, the keys in Wamcats radio shacks begin to pound out a warning to California citrus growers. Fishermen listen in for price quotations as a change of a fraction of a cent may send them to other markets.

Freak ACCIDENTS

. . . . *Impossible to Guard Against, Surround You with Strange Perils*

By ARTHUR GRAHAME



BEWARE THE INKWELL

All ready for a day's work, a business man entered his office, sat down at his desk, and the inkwell mysteriously exploded in his face

ACCIDENTS kill almost one hundred thousand Americans each year!

Last year the tragic toll was 99,000. Motor vehicles caused 33,000 of these fatalities. Accidents in their homes killed 30,000 people. Accidents in public places, not chargeable to automobiles, caused 20,000 deaths. Fatal industrial accidents, exclusive of 3,000 included in the motor vehicle total, claimed 16,000 victims.

Accident experts estimate that each year in the United States there are ten million nonfatal accidents, and that each year accidents cause us a direct economic loss of three billion dollars!

Every accident has its cause although that cause isn't always easy to find. For example:

A business man entered his office one morning not long ago. He was feeling fine, all set to break the back of a hard day's work.

Seating himself at his desk, he leaned forward to pick up the topmost letter in the pile of correspondence that his secretary had arranged for his attention.

The secretary, busy in an adjoining room, was startled by the sound of a sharp explosion in her employer's office. She thought: "Someone's shot him!" and rushed in.

The business man was standing a few paces back from his desk. His chair had been overturned. He seemed dazed. One of his hands was pressed over his eyes, and blood trickled from between its fingers.

"Who shot you?" demanded the girl.

The business man answered uncertainly. "The inkwell blew up!"

Then the secretary noticed that black ink was spattered grotesquely over his face and over the pile of letters, and that little pools of it stood on the once-immaculate desk top.

She called a physician, who found that one of the man's eyes was cut so badly that its sight was endangered. The victim could tell him only that the inkwell had exploded as he sat at his desk, and that one of its hard-driven fragments had struck him in the face.

An accident? An insurance adjuster could find no other plausible explanation of the incident. He did suggest that some enemy might have placed a small quantity of some powerful explosive in the inkwell, but the business man was certain he didn't have an enemy in the world. All the evidence available was the fragments of broken glass and the victim's injured eye.

The adjuster could do no more than guess, so he guessed that the morning sun shining through the heavy glass of the inkwell had produced sufficient heat to cause the ink in it to explode. Chemists insisted that nothing explosive is used in the manufacture of ink. The adjuster shrugged his shoulders and added another to his list of unexplained mishaps.

All of which seems to prove that the astute Monsieur Voltaire knew his accidents when he wrote: "It is the danger that is the least expected that soonest comes to us."

THE patrons of a restaurant in Bethlehem, Pa., didn't think they were rushing into peril when they stepped into their favorite eating place for luncheon one day last March. Even those seated closest to John Bosak, a Lehigh University engineering student, weren't apprehensive.

While they were eating there was an explosion. It rocked the restaurant, and several of the lunchers were injured by knives and forks that were hurled about by the blast. Horrified glances at Bosak, who was groaning on the floor, convinced those present that he had blown up! A physician who happened to be passing gave him medical attention, and found that he had been seriously burned, and that most of his clothing had been torn from his body.

How did it happen? The college student, who had been doing laboratory work that morning, had concocted an explosive chemical mixture in a test tube, and had placed the test tube in one of the pockets of his waistcoat. The heat of his body had caused the chemical to explode.

Quite as unexpected was the danger that overtook a factory worker recently. His glass eye exploded while he was at work! He was knocked unconscious, and suffered severe and painful injuries.

Neither exploding inkwells, exploding engineering students, nor exploding glass eyes are so common as to be accident hazards serious enough to frighten most of us. Even less common is the accident of being struck by a falling meteor. Yet we run an off chance of even that strange fate. Stones from meteoric falls are picked up in the United States on an average of

KILLED BY ELECTRICITY

A plane crashed and became entangled in high voltage wires. As it burst into flames a man turned an extinguisher on it. The stream acted as a conductor and he was fatally shocked

DANGERS
That Lurk in Unexpected Places

BATHTUB . . . . . *More dangerous than airplane flight*
GLASS EYE . . . . . *One exploded with serious results*
METEOR . . . . . *One killed a Central American general*
HOUSE WIRING . . . . . *Even low voltage may cause death*
SNAKES . . . . . *Pilot is bitten by rattler mile above the earth*
GOLF BALL . . . . . *Missing one blinded the player*
HORSESHOE . . . . . *Good luck symbol fell on man's head*

DANGER IN KITE FLYING

Mothers may think their boys are enjoying a harmless sport while flying kites and generally this is true, but occasionally current travels down the string with fatal results

DON'T MISS THE GOLF BALL

A golf player, taking a hard swing at his ball, missed it, struck a tree root, and found he was blind. He had an eye disease that was rendered acute by the shock of striking the root

one every sixteen months, and mathematical sharps have calculated that once every 9,300 years an American will be struck by one.

And yet, only twenty-five years ago, a falling meteor put an end to a Central American revolution.

GENERAL PABLO CASTILLIANO, leading a revolt against the Nicaraguan government in 1906, was sitting quietly in his tent one night in a jungle camp near Puerta Cabezas. A meteor hurled out of some unknown reach of space ripped through the canvas and killed him. His soldiers, believing that Castilliano had been removed from the world by an act of God, decided that he had been an emissary sent to them for their ruination by the Devil, and straightway quit the revolution.

Much more immediate than the danger of being hit by a falling meteor is the danger of being struck by lightning. The odds are only seven thousand to one against an individual being struck at some time during the span of a seventy-year life, and only a half million to one against him being struck during any given year.

Those are the mathematical odds, but the bolts from the heavens didn't run true to form for M. Caesar Beltram, a citizen of Lyon, France. Monsieur Beltram was struck by lightning no less than five times before he was killed—and pneumonia, not lightning, ended his life!

Far more dangerous than nature's bolts is man-made electricity. In the United States, fewer than five hundred people a year are killed by lightning; more than double that number are killed by accidental electric shocks through coming in contact with high voltage wires.

Even the most nervous mothers feel pretty much at ease when their children are amusing themselves by flying kites. And yet, unexpected and fatal danger sometimes lurks in even that safe-seeming pastime, for each year many youngsters are electrocuted when their kite strings come in contact with high-voltage overhead electric wires.

Not long ago an electric power line combined with an airplane crash to cause a series of unusual fatalities.

A plane carrying its pilot and a passenger struck a telephone pole. The pilot jumped when his ship crashed, and was injured only slightly.

As the plane fell, its tail became entangled with the wires of an electric power line charged with 4,800 volts, and when its nose came in contact with the ground the metal parts of the plane completed the circuit between the wires and the earth. The passenger received a fatal shock, and the plane caught fire. A mechanic rushed up close to the blazing ship and directed a stream from a fire extinguisher on the flames. The liquid from the extinguisher acted as a conductor for the electric current, and the mechanic was killed. Seeing the man helpless on the ground, and not realizing what had happened, a bystander pulled the mechanic away, began working the extinguisher, and also was electrocuted!

JUST FOR LUCK

A lucky horseshoe, nailed above the door, brought bad luck to the man whose head it fell upon

Most flying accidents occur on the ground. Of 314 recent air-transport-line accidents, 230 were caused by forced landings; or were landing, take-off, or taxiing mishaps. But even when the flyer is "safely" in the air, he has to face a full share of dangers.

P WIGGINS, of Scott City, Kansas, experienced one that was unexpected. While flying alone almost a mile in the air, he was bitten by a rattlesnake! He was fortunate enough and level-headed enough to make a safe landing, and to obtain medical assistance before the poison had a fatal effect. Just how the rattlesnake happened to be a passenger in the plane remains a mystery, but Wiggins thinks that it must have crawled in while his ship was parked overnight in a field.

While the fatality and injury rates in all civil aviation have not improved in recent years, scheduled flying in air-transport-line planes becomes safer with each passing year. In 1930, in almost 37,000,000 miles of flying by American transport planes, only eight pilots and twenty-four passengers were killed, and only twenty pilots and twenty-nine passengers were injured. In the past two years there has been an improvement of 87.5 per cent in the fatality rate per million miles flown in scheduled air-transport operations.

Despite this lessening of passenger flying danger, flying remains the most hazardous method of getting from some place to some *(Continued on page 133)*

New Indian Poison

Powerful Vegetable

A JUNGLE poison known as rotenone is America's newest weapon against destructive insects. Thirty times as deadly to bugs as arsenate of lead, commonest insecticide, it is already being tried out successfully in the field against codling moths, European corn borers, and Mexican bean beetles. For all its power it is harmless to man. Its discovery is hailed as one of the most important victories yet won in the war on insect pests.

Insects cost the lives of 75,000 Americans and destroy more than $900,000,000 worth of produce each year. The war against them is being waged on many fronts, scattered through the country. At Chicago a death chamber is executing flies so that new poisons to kill them may be tested. A "model insectary" at the University of California breeds dangerous insects, for study, behind barred doors. And at Silver Springs, Md., a small band of experimenters of the U. S. Department of Agriculture has just given us rotenone, the new weapon that may rout the insect horde forever.

Science and exploration combined to reveal it. First the experimenters in the Maryland laboratory devised a way to test the strength of any poison. Measured doses were fed to silkworms on poison

These big fly traps were set up outdoors by North Dakota entomologists, near spots highly popular with the pests, and baited with liver and syrup mixture

In this container, flies are hatched under carefully controlled conditions so that the effect of the exterminator can be noted. Right, death chamber for common pest

At the great new insectary of the University of California new methods of pest control are being sought. Above, observing insects on young palm trees

Below, incubators in which flies for experimental purposes are bred. Later they go to the death chamber for use in testing the strength of various poisons

Aids War *on* Bugs

Insecticide Harmless to Human Beings

sandwiches made of disks cut from mulberry leaves. Weighing the silkworm and the amount of poison he ate showed just how much poison would kill how much bug. Thus the experts compared concoctions from all over the world.

It was to the South American Indian that they went for rotenone, with which the natives of the Amazon catch fish. Crushing the roots of a tropical plant called cube, pronounced coo-bay, they extract the poison and dump it into a flowing stream. Even so greatly diluted, the poison stupefies all fish near by. Indians gather the fish that float to the surface and eat them, apparently without harm from the poison.

The men at Silver Springs obtained a small quantity of rotenone and tried it on silkworms. Their greatest hopes were exceeded in the tests, which showed that a single ounce of the poison would kill ten tons of insects. Unlike lead arsenate and other common poisons, it was entirely harmless to human beings.

At present rotenone costs $10 to $20 a pound—too much for the average farmer. But plans are being made to grow it on a large scale, possibly in the Virgin Islands, where the climate is suitable to the cultivation of cube and of derris, an East Indian plant that also supplies rotenone.

A second stronghold of America's insect fighters is the model insectary just opened at the University of California—the first of its kind in this country and the most complete in the world. Here the most dangerous insect pests known to orange growers of the West are raised in locked rooms. Even the ventilating system is screened to prevent the ruin that would follow their escape. Meanwhile their habits are studied, and insect parasites brought from far countries are tried out against them, to learn how to combat them on the ranches.

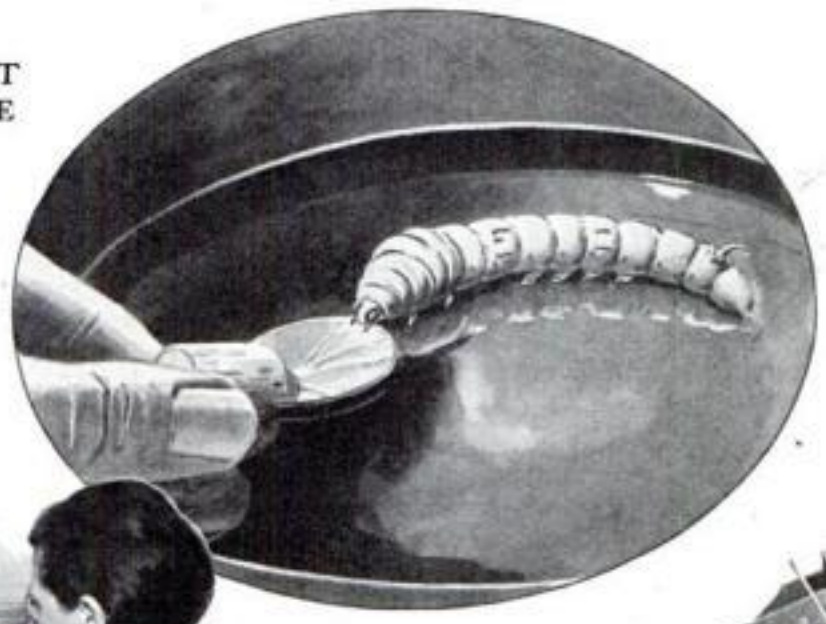
Flies are the "public enemies" against which a research organization of Chicago is concentrating its attack. Thousands of the disease-carriers are bred daily, to be put to death in a novel fly death chamber by various insecticides under test. So far the most effective fly poison found has been an extract prepared from dried and compressed flowers of the Pyrethum, a chrysanthemum from Japan.

Meanwhile Government bug-fighters at the North Dakota Agricultural College have even gone out into the great outdoors to combat the common fly. When they set up, near a market place, huge, cone-shaped traps of wire netting, baited with a liver and syrup mixture, shopkeepers declared the fly nuisance visibly abated.

1. Poison sandwiches for silkworms are made from small disks cut from a mulberry leaf

2. Compressed air enters this bell jar from below and carries with it a cloud of poison dust that settles on the bit of mulberry leaf which is to be fed to the silkworm. In this way record is kept of the poison used

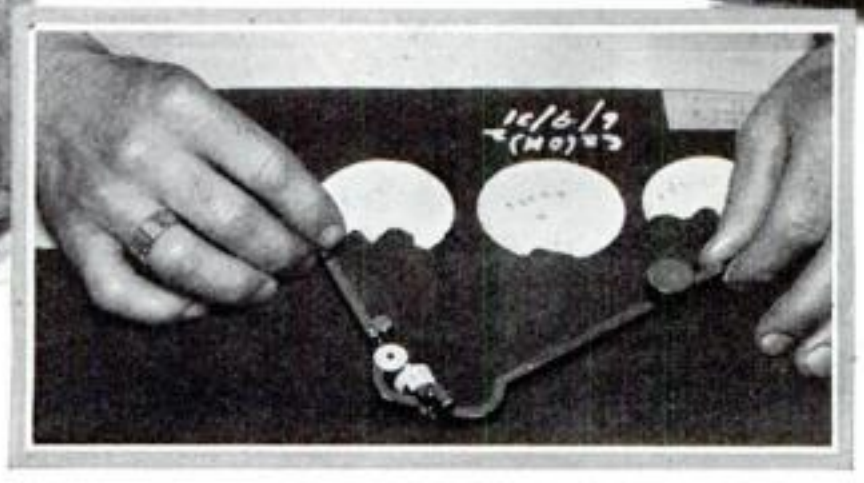
HOW GOVERNMENT TESTS INSECTICIDE



5. At right, the innocent silkworm gets the fatal leaf. Mulberry is its favorite food and the worm eats readily of the poison sandwich offered it

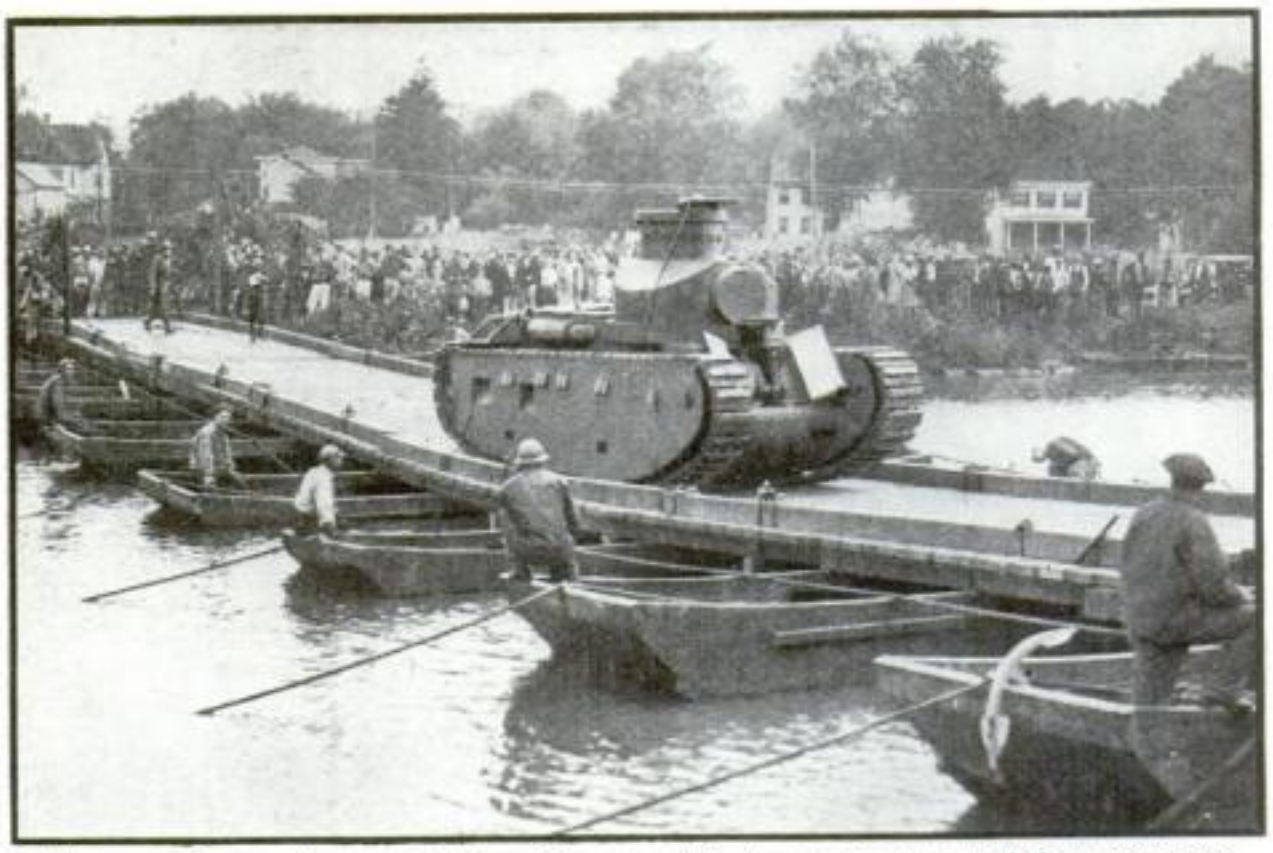
4. Before they get their sandwiches, the worms are accurately weighed. Then, knowing the amount of poison consumed, it is easy to determine the lethal dose in proportion to the body weight of victim

6. Below, partially eaten sandwiches are photographically enlarged and amount eaten is accurately found



3. Covered with poison dust the leaf disk is taken from the jar and another disk of the same size, smeared with starch paste, is laid on top to complete the deadly sandwich

Metal Pontoons Support Bridge for 23-Ton Tank



This new style metal-pontoon bridge safely supported a twenty-three-ton tank in a recent test

GETTING a tank across a river in double-quick time is now possible even when no permanent bridge is there, as U. S. Army engineers demonstrated at Fort Dupont, Del., the other day. With the aid of big metal pontoons of a new type, they speedily threw a bridge across a river. Then a twenty-three-ton tank lumbered safely across. The new style of bridge can sustain heavier loads than any previously used by the Army. The metal pontoons, which are quickly and easily maneuvered into place, are said to be decidedly more buoyant than those previously used and are more strongly built to withstand hard usage without damage.

Aquaplaning on a "snow surfboard" is the latest in winter sports. It can be towed or used for coasting

TRAFFIC CHIEF'S FLYING FINGERS COUNT CARS

PROBABLY the man with the busiest fingers in California is R. T. Dorsey, Los Angeles traffic department chief. He sits at each of the city's street corners in turn, noting the flow of traffic. His right hand records upon a series of mechanical counters the number of automobiles that pass, while his left hand meanwhile keeps tab on the number of pedestrians in the same fashion. At the peak of the rush hour, Dorsey's fingers move with the rapidity of a pianist's. The hourly totals of auto and pedestrian traffic will be used to decide where stop-go signals and traffic officers are needed.

Los Angeles' chief of traffic counts cars with one hand and pedestrians with other

SNOW AQUAPLANE TEST FOR SENSE OF BALANCE

THIS winter a new type of vehicle is expected to join bobsleds and skis on snowy slopes. It is a "snow aquaplane" built like a surfboard, and it is said to furnish thrills aplenty when the rider attempts to balance himself on it for a coast. The device, which has just been placed on the market, was invented by a real boy when coasting on a sled grew too tame for his adventurous spirit. Coasting on its center runner, a dizzy speed is attained if perfect balance is maintained.

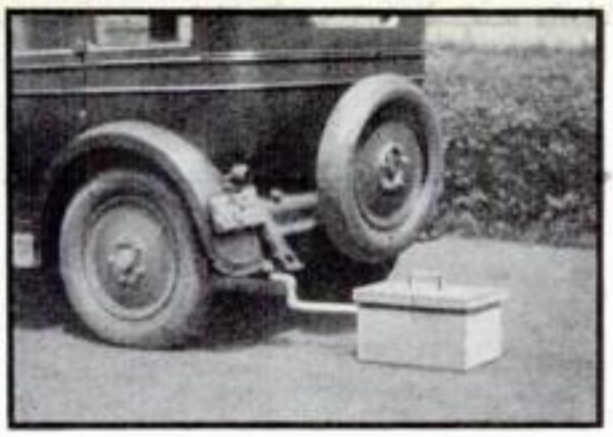
PLANE'S EXHAUST KEEPS ICE OFF THE WINGS

HEAT from a plane's exhaust avoids the peril of ice on a plane's wings and propeller, in a model developed by Dr. Merit Scott, Cornell University physicist. Hollow passages lead exhaust gases along the plane's leading edge and through the propeller. Tests in a refrigerating wind tunnel showed that no ice would form on the surfaces thus warmed.

GOLFERS CAN NOW USE THEIR CLUBS INDOORS

GOLFERS can get the same driving practice indoors that they have on a full size course, with a device invented by a Washington patent draftsman. The golfer drives at the ball on the floor and the small ball on the table travels down a fairway scaled to indicate the distance that the large ball would travel on a regular course. The distance of the fairway on the table represents an actual one of about 300 yards.

When the golfer swings at the ball attached to this indoor practice device, a small ball on the table moves to indicate the distance which the golf ball would go if hit on the fairway

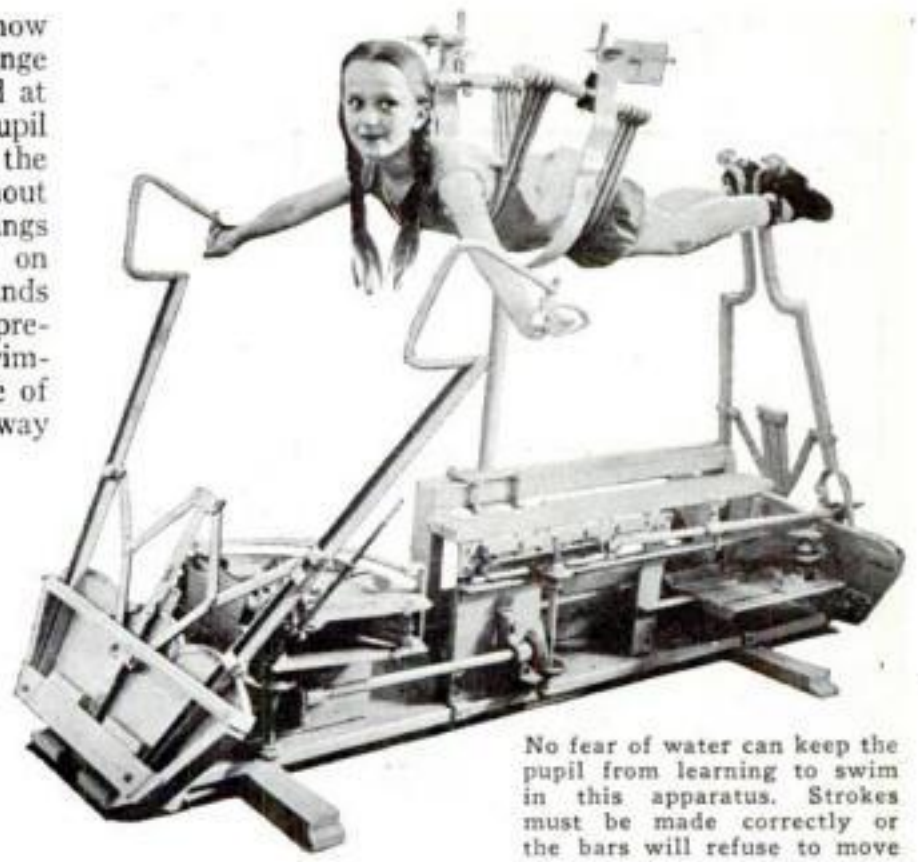


USES CAR'S EXHAUST GAS TO KILL SICK PETS

BECAUSE he believed he could find a more humane way of executing animals than having them shot by policemen, a New Britain, Conn., man constructed a device that may be attached to the exhaust of his car. Now owners of hopelessly sick cats and injured or mad dogs call him to put pets out of their suffering. Placed in the homemade death chamber, the animal is painlessly dispatched in only ten seconds' time by the deadly fumes of carbon monoxide gas in the exhaust.

SWIMMING TAUGHT FAR FROM WATER

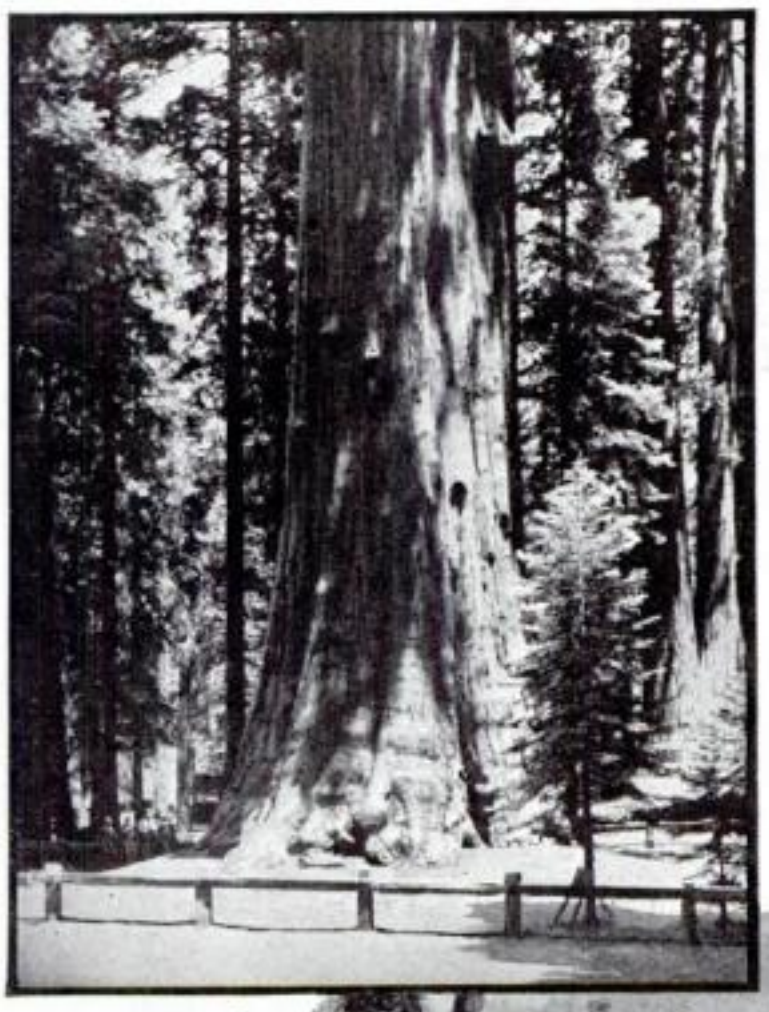
SWIMMING is taught now on dry land by a strange device recently exhibited at Kiel, Germany. The pupil who wants to master the art of swimming, without going near the water, hangs suspended in mid-air on comfortable webbed bands and goes through the prescribed motions of swimming under the guidance of an instructor. In this way the most difficult strokes may be learned before the novice even enters the water. The pupil is forced to make the swimming movements correctly and in the proper rhythm. Any attempt to jerk or alter the movements will be met with resistance from the moving bars seen in photo.



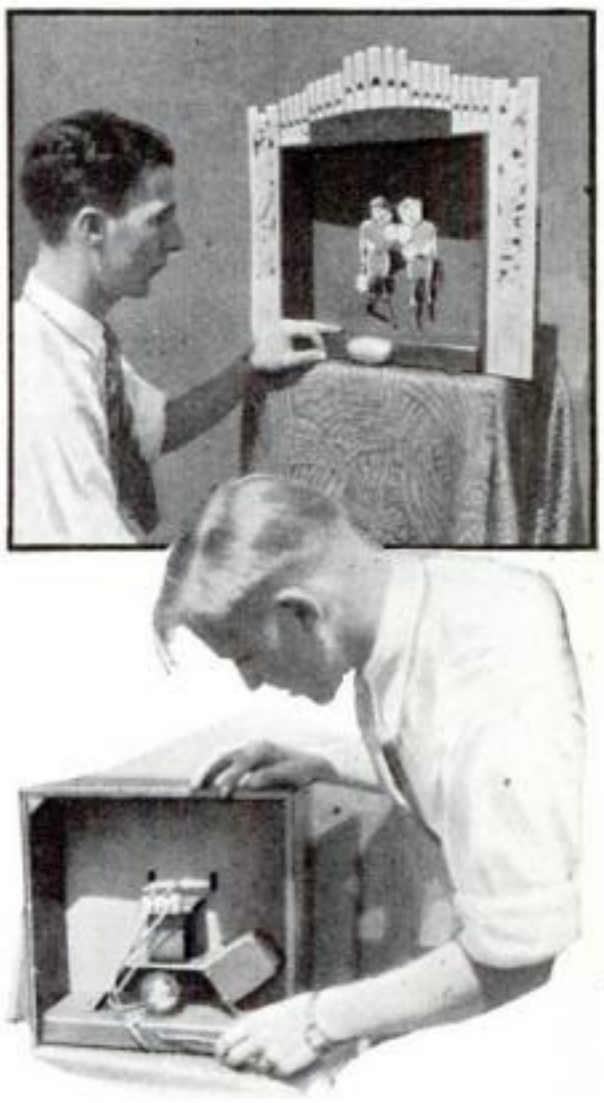
No fear of water can keep the pupil from learning to swim in this apparatus. Strokes must be made correctly or the bars will refuse to move

TREE IS LARGEST OF LIVING THINGS

WHALES of the present and mighty dinosaurs of the past must cede to a tree the honor of being the world's largest living thing. That title goes to the huge redwood tree known as "General Sherman" in Sequoia National Park, Calif., according to a recent survey made by the engineers representing the California State and Fresno Chambers of Commerce. Its volume of 600,120 board feet would be sufficient to build enough five-room houses to cover three city blocks, or to provide 30,000,000,000 matches—a box of fifteen for every man, woman, and child on earth. A train of thirty cars would be needed to move its gigantic trunk. The engineers spent several weeks in making the first comprehensive and precise measurements ever taken, with exact scientific instruments, of the most famous of the forest giants. More than a thousand measurements were made of each tree to compute its volume. The General Grant, another mighty tree, contains nine tenths the volume of the General Sherman but is larger around the base and taller.



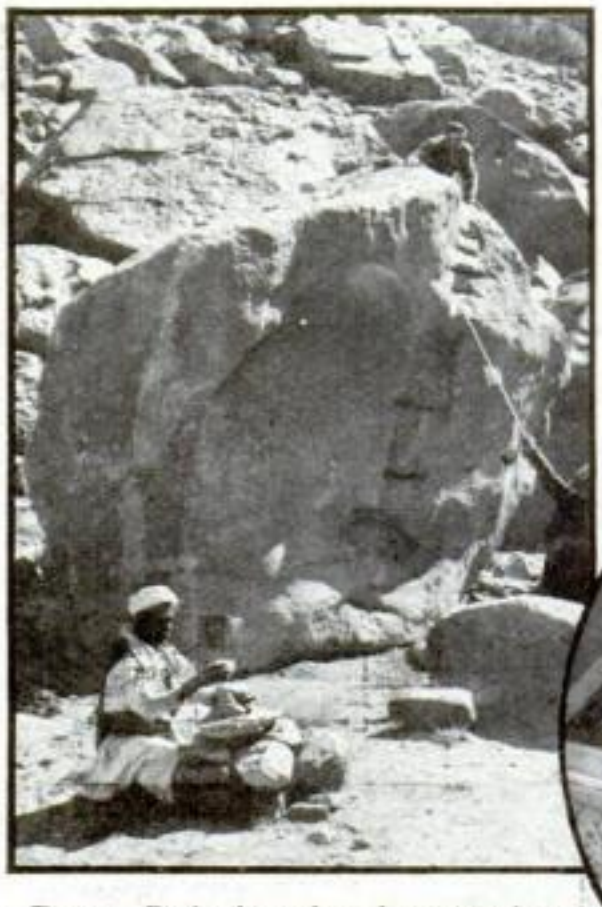
Left, above, largest living thing, General Sherman redwood tree; and men who measured it



TINY FIGURES DANCE TO RADIO MUSIC

TINY animated figures dance to the tunes of radio music, in an advertising device recently invented. The jointed figures are attached to the coil of a loudspeaker of the dynamic type, in which there is considerable movement. A special form of dynamic speaker, which produces no sound but whose coil has an unusually large distance of travel, was developed for the purpose. Since the miniature dancers move with the diaphragm, they do a jig in perfect time with music from another speaker. Set up in a store window, the dancing marionettes attract the attention of passers-by.

EARLY FORM OF ALPHABET FOUND ON OLD TABLET



Left, the traditional place, at Mount Sinai, where Moses received the tablets containing the Ten Commandments. Inscriptions found among Egyptian ruins near by point to it as birthplace of our alphabet

Above, Martin Sprengling of the University of Chicago, who suggests that a Bedouin mine foreman may have invented our alphabet. At left, an old Bible manuscript at the Sinai Monastery. Note how its characters have evolved from early picture writing, though still far from ours

DID a Bedouin mine foreman invent our alphabet? This suggestion, seriously put forward by Prof. Martin Sprengling, of the University of Chicago, throws new light on the humble beginnings of the characters we use daily. It follows Sprengling's recent success in deciphering several inscribed tablets and stones found among Egyptian ruins at Sinai, on the north end of the Red Sea. These have been a riddle since they were discovered in 1904. Now most of them turn out to be addressed to the goddess Balaat, an ancient Semitic deity. At least one, the message indicates, was written by the Semitic foreman of one of the nearby Egyptian copper mines probably about the year 1900 B. C. He may have been the first to drop the custom of his time to write in pictures, and to substitute arbitrary characters of his own invention as a time-saving expedient in keeping records of mining operations. These inscriptions, therefore, seem to supply the "missing link" between early picture-writing and the vowelless, twenty-two-letter alphabet of the Phoenicians. The latter, authorities have long agreed, was the direct ancestor of the modern English alphabet, with Greek and Latin as intermediate steps. Its own predecessor, however, has long been in doubt.

WHEAT DAMAGE DUE TO ELECTRICAL WINDS

STRANGE "electrical winds" that sweep across the Kansas plains are blamed for the damage to wheat and other grains by S. D. Flora, state meteorologist. During dry weather, he points out, a familiar phenomenon in the western part of the state is electricity-bearing winds that charge wire fences and steel windmill frames to such an extent that a person touching them receives a severe shock. When the air is full of dust, Flora reports, the electrical winds are most common and seem to do the most damage. The damage to crops usually occurs in streaks, as during hailstorms.

TRACTOR FIRE ENGINE

ON FIRE ISLAND, near New York City, fire engines are fitted with tractor treads. So deep and soft is the island sand that ordinary wheeled engines would have a hard time getting anywhere. With tractor treads, however, it has been found that fire apparatus can quickly reach any part of the settlement threatened by a blaze. Before the motor engines were delivered, residents of the island dragged old-fashioned hand engines to a fire.

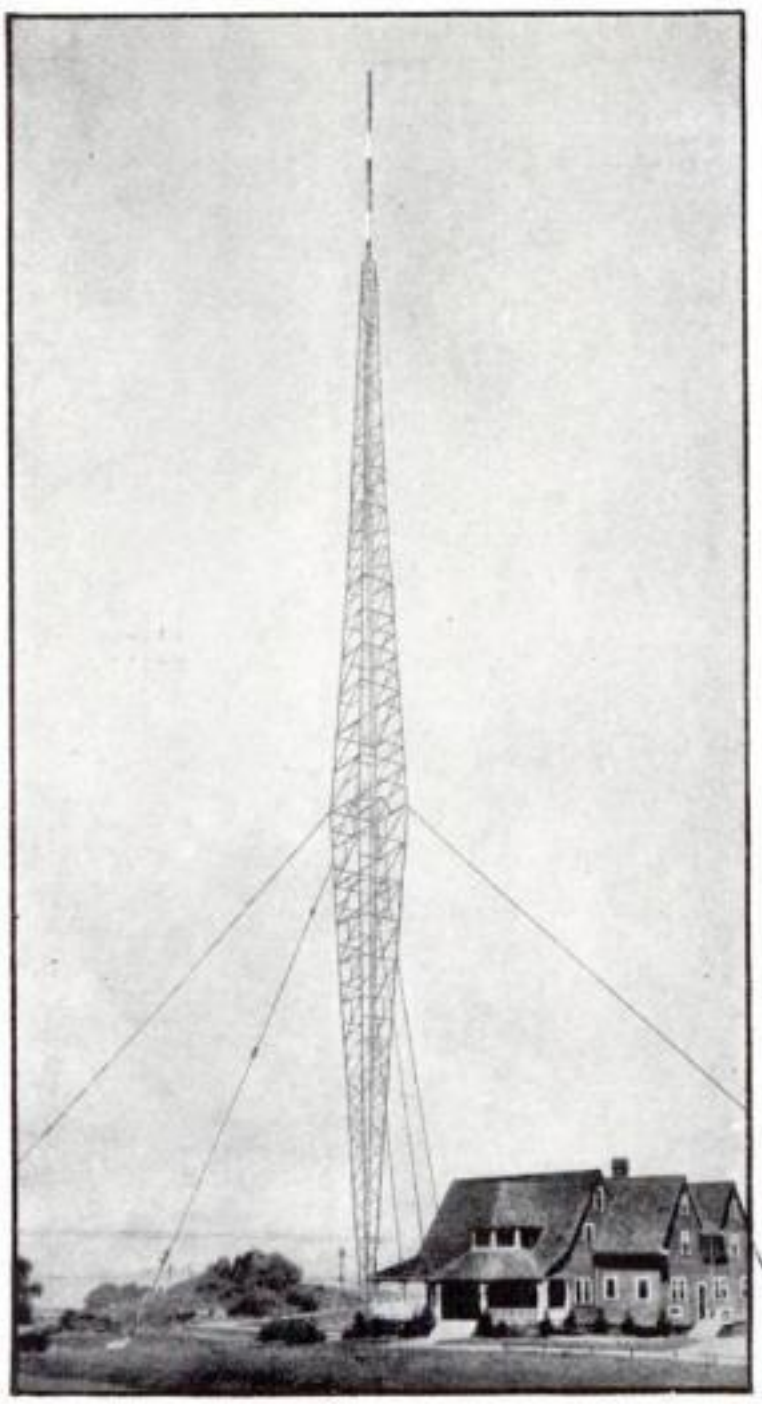
EXPENSE MEMO ON AUTOMOBILE'S STEERING POST

JUST how much it costs to run a car is no mystery to the user of a handy new memo-pad-and-pencil kit that clamps to the steering post. Each time he stops for gas, he jots down the amount. A lamp illuminates the roll pad at night. Touching a lever folds it out of the way.

HOUSE IN WATER TOWER

DISGUISED as a house, this odd 10,000-gallon water tank supplies the residents of Thorpeness, England. Thus they transformed what would have been an eyesore into a landmark that draws the attention of visitors. The base of the tower contains a dwelling of ten rooms.

RADIO TOWER SERVES AS ANTENNA



RADIO towers that serve as antennas, without the need of additional trailing wires, are the fashion now. First of this new type to be erected for broadcasting purposes was recently completed at Squantum, Mass., for station WAAB. The whole 430-foot tower of steel is its own aerial. The tower rests on a porcelain insulator tested to a compression of 1,000,000 pounds. Four guy wires, each under a 50,000-pound strain, hold the tower in place. To tune it to emit a radio wave of the proper length, a seventy-five-foot pole at its top may be raised or lowered at will. An aviation light of 2,000-watt power will surmount the strangely-bowed structure. Not long ago this style in radio antennas was inaugurated by a similar "radiating tower" of 221-foot height erected for the Akron, Ohio, police (P. S. M., Mar. '31, p. 52).

HOOP ON TENNIS NET TESTS PLAYER'S SKILL

"HOOP tennis," a new California sport, adds extra thrills to a popular game. The rules are the same as for ordinary tennis, except that it is not enough to return a ball over the net and into the opposite court. It must pass each time through the large hoop set at the center of the net, or the opponent wins the point. Those who fancy their skill with racket and ball find this a far more difficult test of their prowess on the court.

AUTO PIONEER INVENTS SELF-STARTING MOTOR

WHILE two automobile makers are now introducing cars that start automatically at the turn of the ignition key, by wiring the starter to the instrument board instead of to a foot button, a famous automobile pioneer has just invented an automobile motor that entirely dispenses with an electric starter. Charles E. Duryea, of Philadelphia, who built his first automobile forty years ago, expects this innovation to revolutionize the design of modern cars. At sixty-nine, he is perfecting the motor preparatory to placing it on the market, and in the meantime details of its construction are carefully guarded. However, the photo shown indicates its radical design.

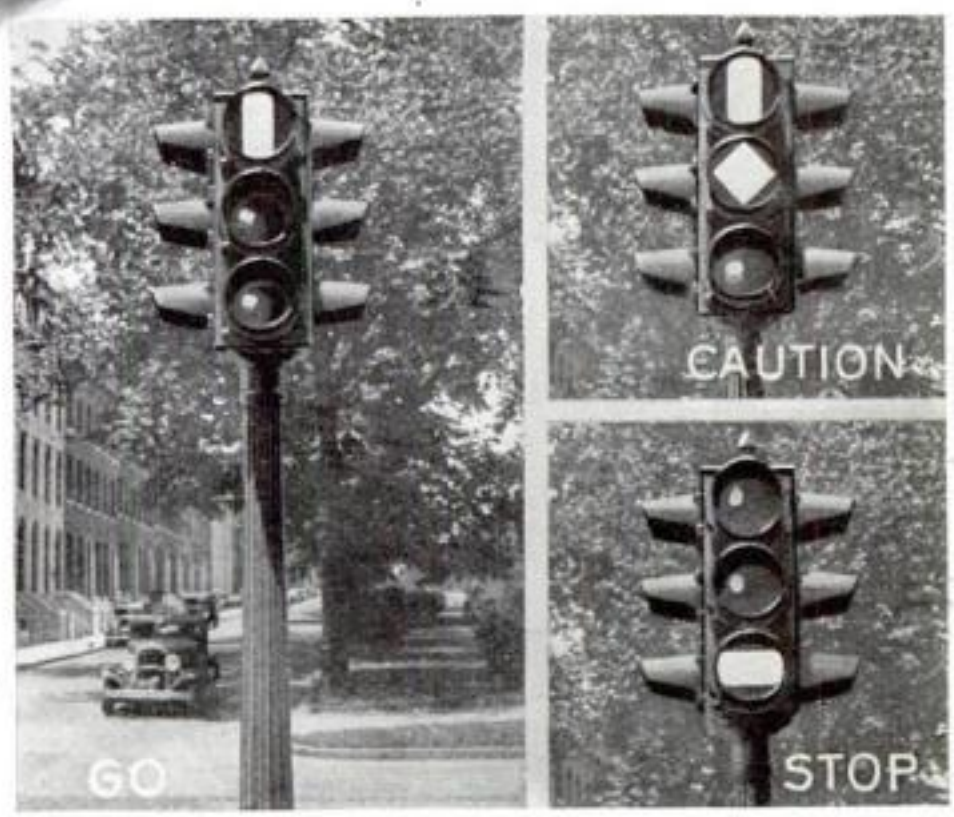
Above, an entirely new type of automobile motor that has no self-starter. It is the invention of Charles Duryea, pioneer car builder

CURVED PLATES IN NEW TELESCOPE

CURVED photographic plates, made of seven-and-a-half-inch disks and ground to a concave surface, will be used in the new forty-inch telescope to be built at the U. S. Naval Observatory, Washington, D. C. Designed by Prof. George W. Ritchey, astronomer-inventor, the instrument will be only half as long as the present type of reflector, yet will have the same degree of magnification.

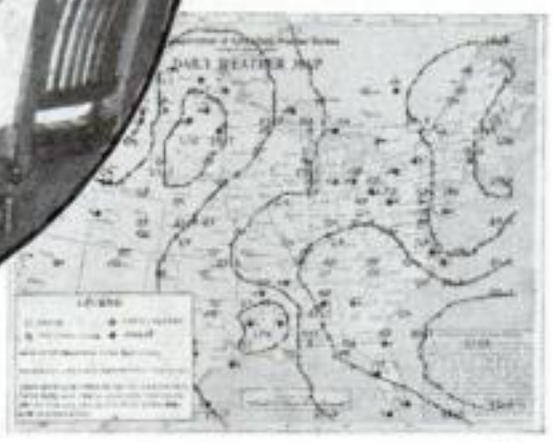
SHAPE OF LIGHT NOW GUIDES TRAFFIC

EVEN a color-blind motorist cannot fail to understand a decidedly unusual traffic signal being tried out in Baltimore, Md. Latest invention of Charles Adler, Jr., noted signal engineer, it combines form with color to make interpretation of the signals easy. Thus a green light always appears as a vertical bar, an amber light is diamond-shaped, and the red light is a horizontal bar. In the photographs, the three indications for "go," "caution," and "stop" are shown. Absent-minded drivers as well as color-blind persons may also find the new system more recognizable, the inventor says. They are known as "color-design" signals. Adler has also invented signals which are automatically controlled by sound vibrations by moving traffic, so no driver is stopped unless there is cross traffic.



Traffic lights are made prominent by giving each color a distinctive shape

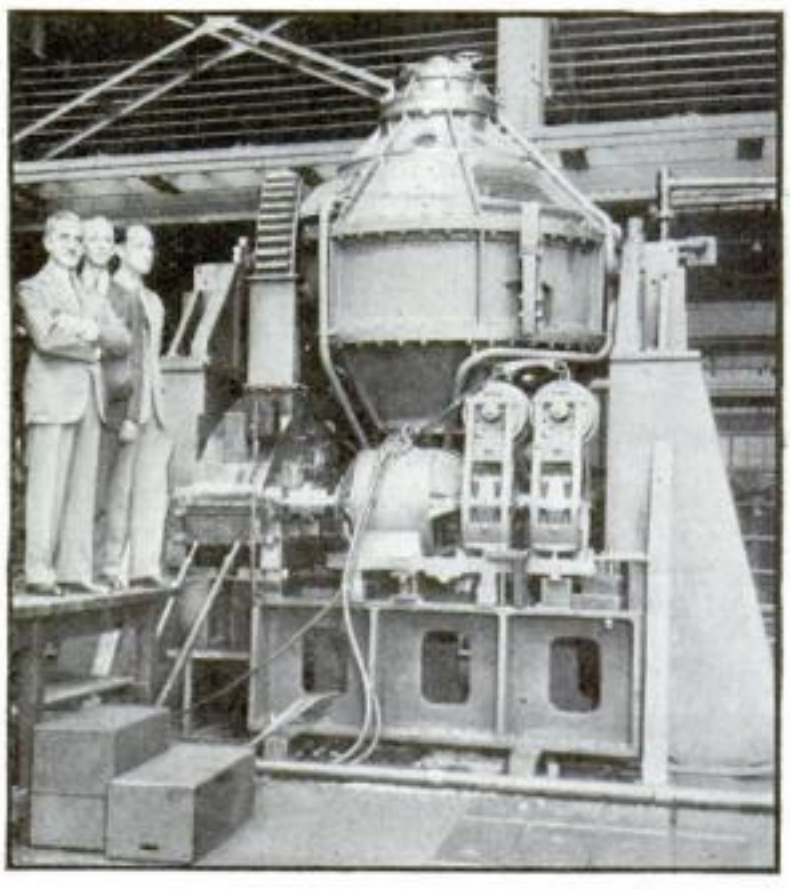
Flyers Get Weather Map Sent by Typewriter in Seven Minutes



Weather map transmitting machine seen above sends out weather map as shown at the right

AN AERIAL weather map was transmitted the other day from Washington, D. C., to New York City by automatic telegraph typewriters. The machines were fitted with special keyboards from which the usual numerals and letters were missing. In their places were keys that print dots and circles, and letters with stubby-tailed arrows attached, familiar sights on weather maps, but never before seen on typewriter keyboards. A blank map was put on the machine at New York. As weather information was received at Washington, an operator there worked the keys of her machine, causing the New York machine to turn a blank map into a complete and up-to-the-minute weather map. This system of supplying early and accurate weather information to flyers was worked out by engineers of the Bell Telephone Laboratories and the U. S. Department of Commerce. It is planned to be worked in conjunction with the automatic electric typewriter service by tape, now maintained by the Department over about 9,000 miles of lines to transmit written weather reports. With the new system in daily use, airports all over the United States could receive complete weather maps within seven minutes after Washington had received weather information. In this way, the delay incident to sending weather maps by mail is avoided. The maps are now received in time to be of vital use to the airplane pilots.

GYROSCOPE IMPROVES SHIP'S GUNNERY



Twenty-ton gyroscope made for the Italian destroyer *Pigafetta*, as aid to gunners, is tested in Philadelphia

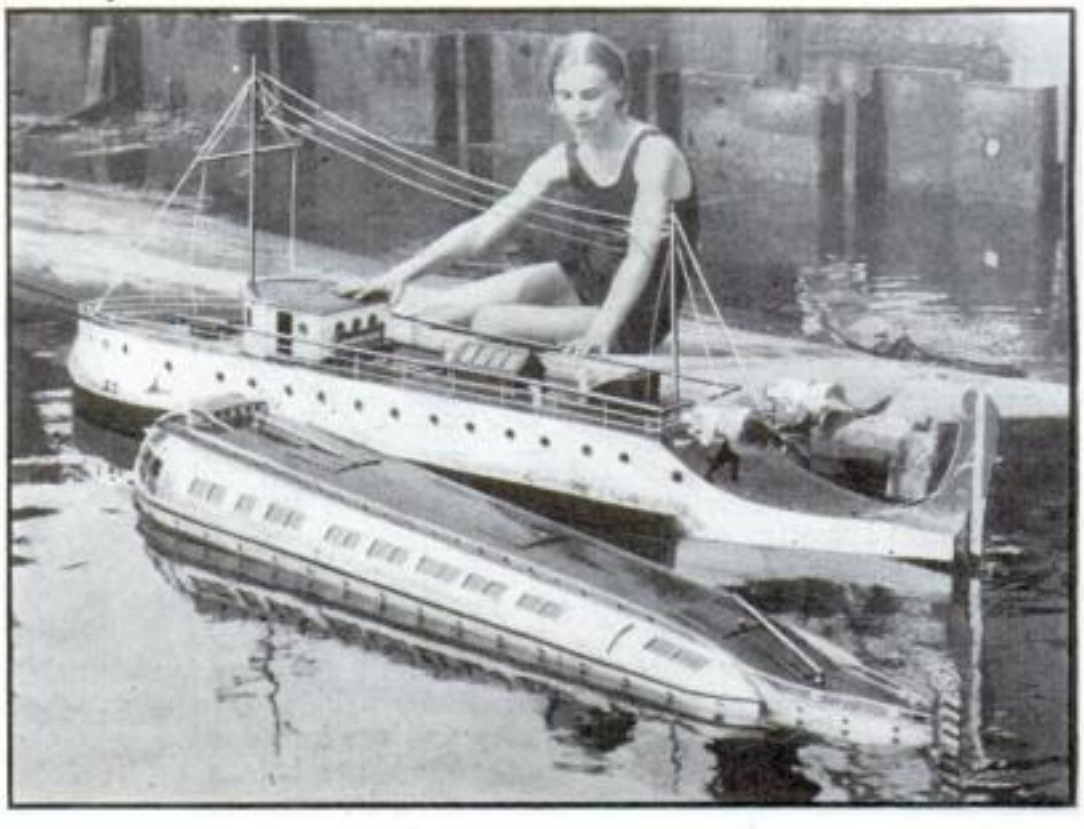
NAVAL officials of five great powers recently gathered to watch a twenty-ton top spin at Philadelphia, Pa. The huge gyroscope was undergoing final tests before being shipped to Italy, where it will be installed in the new 2,000-ton destroyer *Pigafetta*. With its aid, the warship is expected to make new marks in gunnery. Rolling in heavy seas will be stopped by the gyro, permitting accurate fire. In a calm sea, it may be set to cause the ship to roll, elevating its guns at the peak of the list and giving them a longer range.

HATRACK FOR AUTO HOOKS TO WINDOW

WHERE to put a hat, when motoring, so that no one will sit upon it is a problem solved by an ingenious little hatrack of wire. It hangs from the edge of the glass pane of any window of the car. Wraps, pocketbooks, and maps may also be kept handy with its aid. Rubber sheathing protects the glass and the rack does not interfere with opening or closing the window to which it is attached.

AIR AND WATER PROPELLERS MAY DRIVE NEW OCEAN LINER

Now that boats driven by air propellers have proven practical in Germany and other European countries, Marcel de Passy, of Brooklyn, N. Y., visions a ship that will combine the advantages of air propulsion with conventional marine screws. Both types of propellers would drive a 720-foot liner of his design, of which he recently exhibited a model. It would cross the Atlantic in thirty-six hours, he declares. The photograph shows the model of the liner and one of a yacht, similarly propelled, undergoing tests at a Brooklyn shipyard basin. A considerable change in the basic hull design of the ship would be necessary for best results, de Passy says.

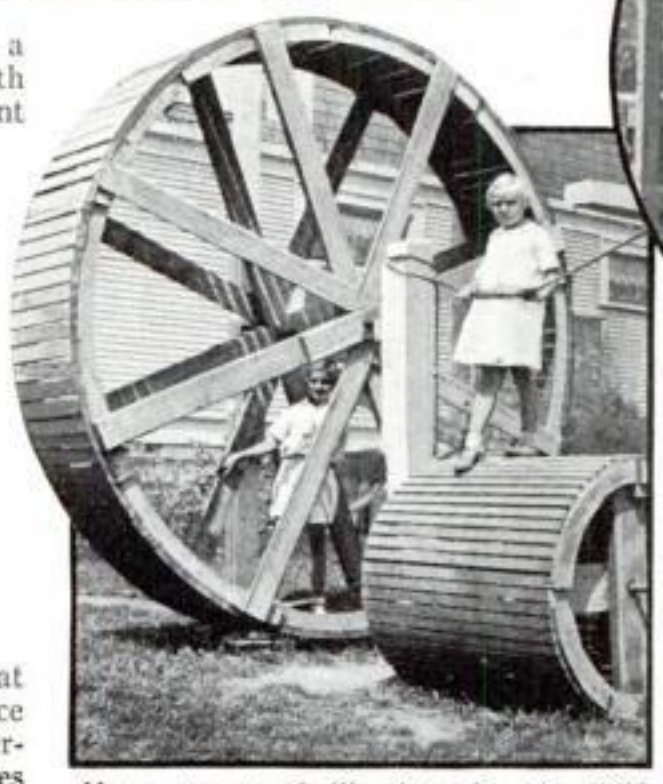


Models of an ocean liner and a yacht which will be driven by combined air and water propellers are being tried out at a Brooklyn, N. Y., shipyard basin

Here is a general view of the homemade carnival built in a private garden for the entertainment of the children. The apparatus is all worked by muscle power

GARDEN CARNIVAL BUILT BY HAND

In a small side yard of his home, a Tacoma, Wash., chemist has built with his own hands a veritable amusement park in which his three children have fun and healthful exercise. So far the work of his leisure hours for several years has produced fourteen pieces of apparatus for the playground paradise, each one worked solely by muscle power, to give the children healthful exercise. Thrills of a roller coaster are provided by an undulating track on which a child's wagon or scooter is the vehicle. By running inside it, a child may revolve a "giant tread wheel" to a high speed and then, grasping iron bars, spin with it head over heels until it stops. A Ferris wheel, ingenious in its simplicity, revolves when the child on the lowest seat kicks the ground. The builder's prized piece is a "tipping top" supported on a universal joint from an old truck, which revolves when the children within it swing their weight from side to side.

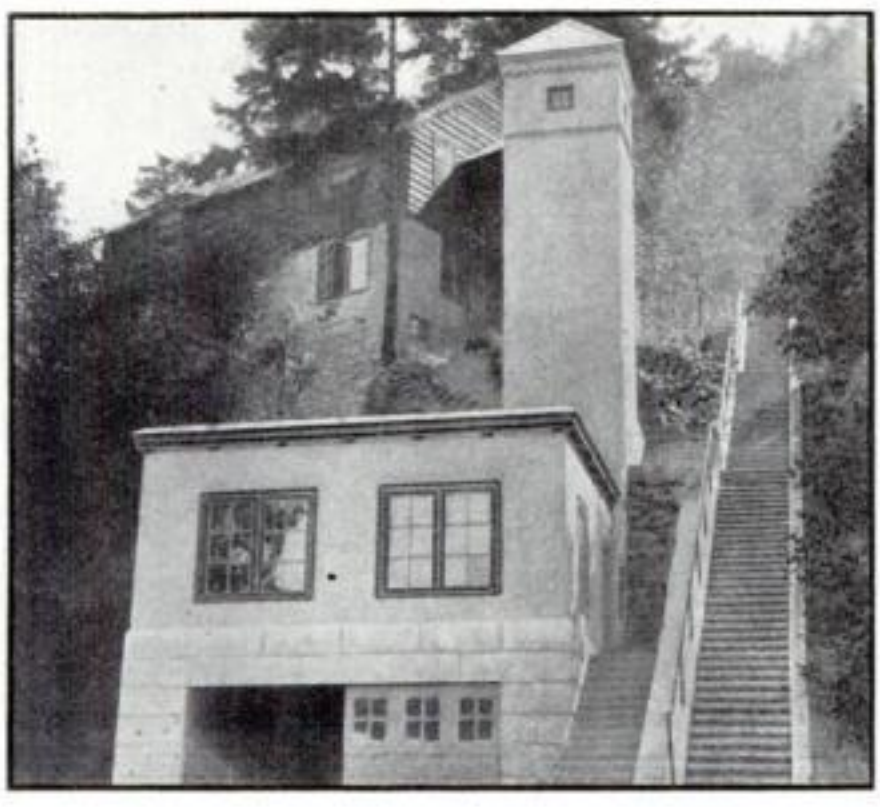


Above, two treadmills that give the child plenty of exercise. In the circle, the tipping top operates as the girls sway from side to side

HEADACHE AIDS WORK

Do you work best when you have a headache? A London doctor has just completed a survey that shows that surprising possibility. He asked women factory employees to note daily on a special blank how they felt and whether they had headaches. Comparing these blanks with records of the daily work each performed, he found that many girls did most work on the days they had headaches. Concentration on their work in order to forget their aches was the explanation offered.

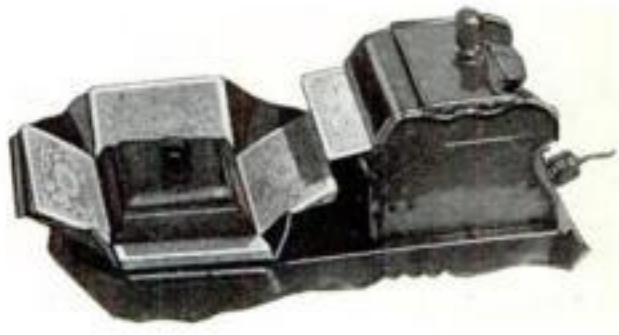
ELEVATOR CONNECTS HOME AND GARAGE



To do away with a tedious climb of fifty feet several times a day, a Portland, Ore., man has built himself an unusual elevator between his garage and residence. The shaft is inclosed and corresponds to the architecture of garage and house, as may be seen in the photo at the left. Additional novelty is given the elevator as the upper floor of the garage is being used as a residence room and the owner frequently will travel between his house proper and the room. The elevator is electrically operated.

NEW AUTOMATIC DEALER SPEEDS BRIDGE GAME

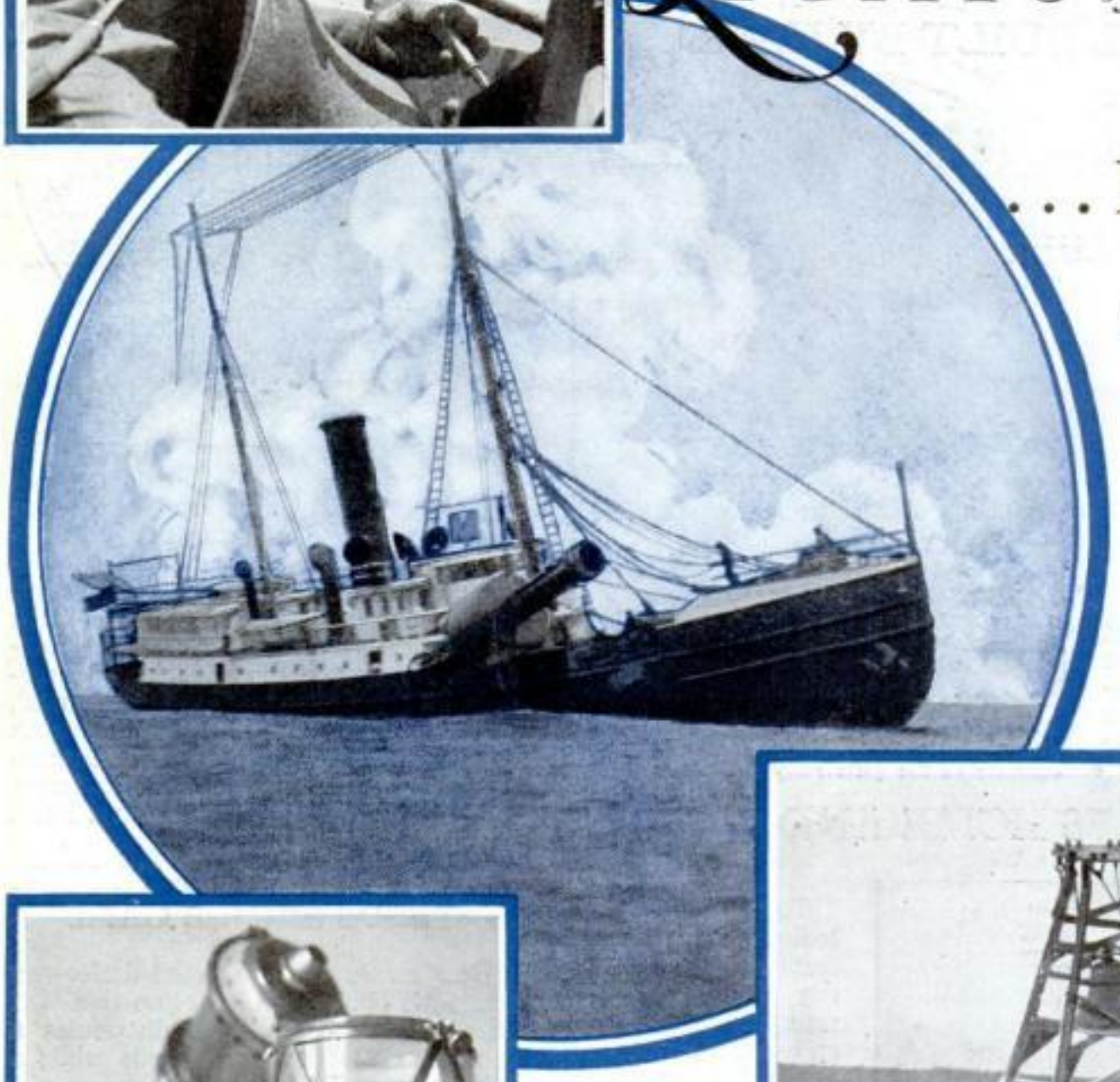
Now comes the robot card dealer—an automatic device that hooks up to a wall plug or light socket, and distributes a deck of cards into four hands while a bridge game is progressing. They are dealt into four receivers on a revolving tray for the respective hands. Cards are shuffled and cut by hand, placed in the automatic dealer, shown below, and are dealt when needed.



Halfway Rock, Maine, over which the waves wash during a storm, is one of the danger spots that the tender must visit. Below, chipping and painting one of the many buoys that guard our coasts

LIGHTS of the SEA

...Kept Bright *by* Constant Vigil *of* Daring Seamen



In circle, tender raises a large whistling buoy that weighs over fourteen tons. Above, note the insects that got inside this lighted buoy and extinguished the warning signal

Winter off the Maine coast tests the stoutest lights and buoys. The one at right has lost three of its clappers and is covered with ice and seaweed. It is up for repairs while another is substituted for it

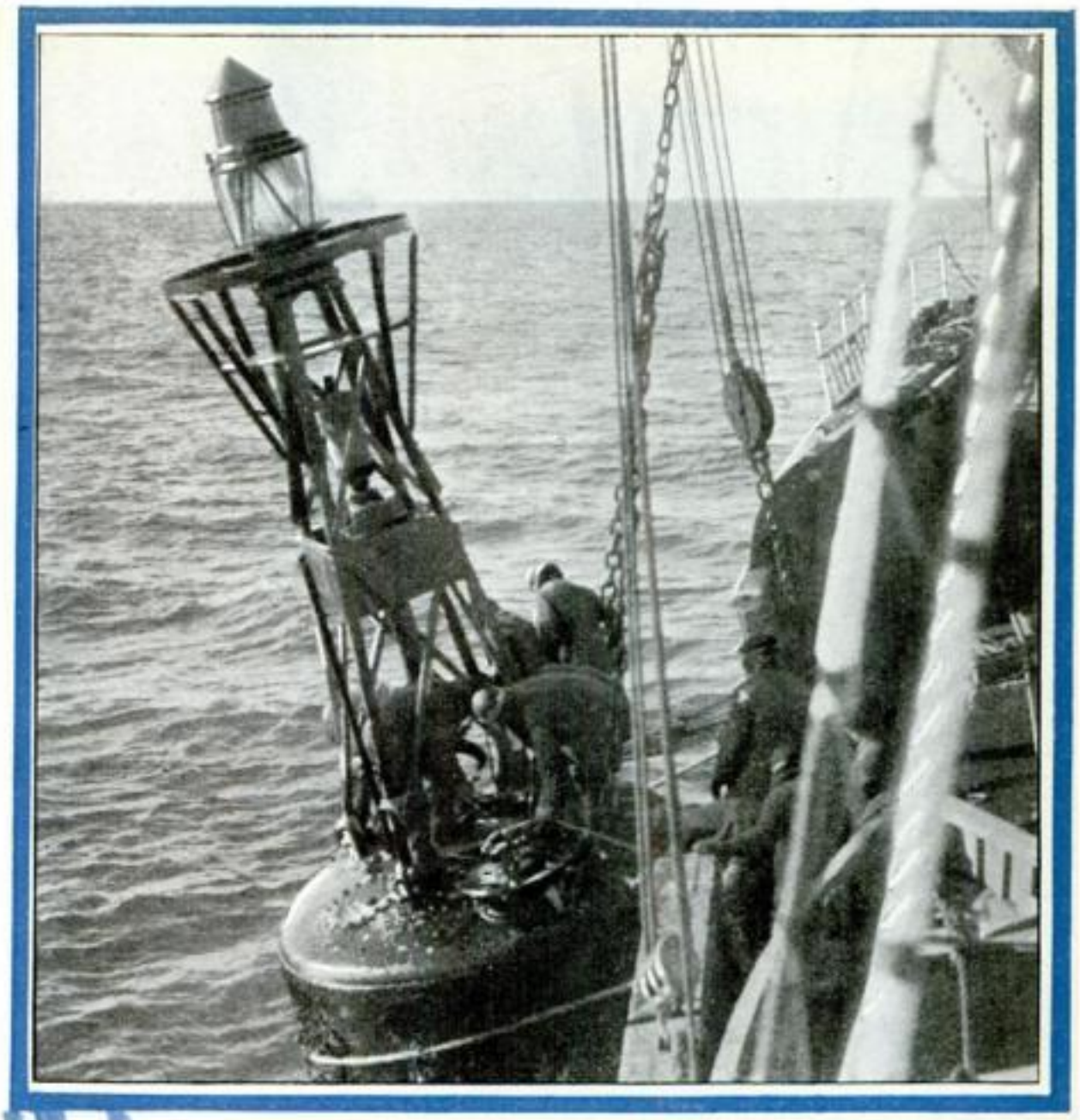
A WORK often hazardous, but never monotonous, is performed by ships and men of the lighthouse tender section of the U. S. Lighthouse Service. Along the nearly 40,000 miles of coast line of the United States, Alaska, and Porto Rico are approximately 20,000 aids to sailors. These are buoys, lighthouses, lightships, and beacons. Each of them requires the more or less constant attention of the crews of the lighthouse tenders.

A fleet of fifty of these sturdy steamers is maintained by the Lighthouse Service. Each lighthouse department has from one to five of them for maintenance of the aids to navigation over which it has jurisdiction. The tenders patrol regular beats. Each buoy on the beat must be inspected, food and supplies for keepers and their families must be left at outlying lighthouses or lightships, and beacons must be serviced.

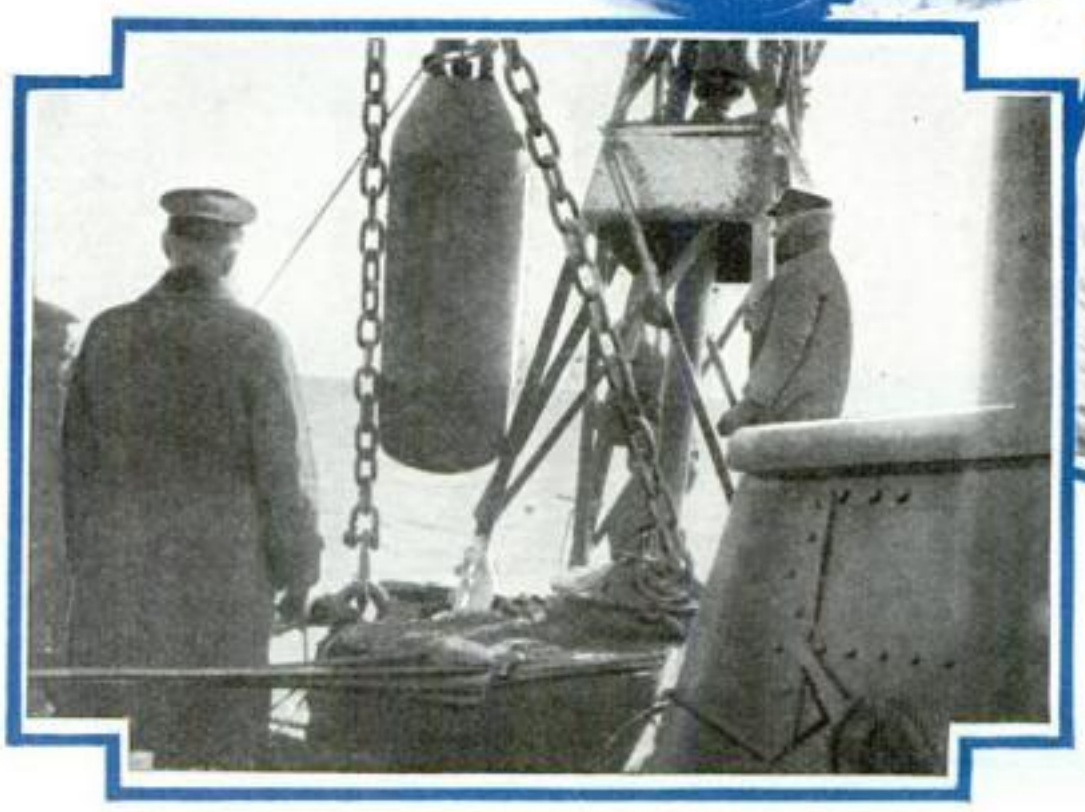
At regular intervals buoys must be taken up from their stations and brought into the lighthouse base for cleaning and painting. At such times new buoys are put in place of the old, for the danger spots cannot be left unguarded. Since buoys may weigh as much as fourteen tons, the work of picking them up and landing them on the rolling deck of small vessels is not easy. For this purpose lighthouse tenders are fitted with heavy derricks and built with a low forward well deck close to the water.

Besides their regular beats the tenders must constantly make special trips regardless of winter gales or summer calms. Has a buoy or light been reported out of order? Then the tender must hasten to repair it. Has a buoy been damaged by a passing vessel? Then the tender must take out a new buoy and remove the one that has become a menace to safe navigation.

Since buoys and lights are set at hazardous portions of the coast line, it follows that the tenders must constantly be nosing into danger spots from which all other ships are warned away. In fair weather or foul they make the sea highways safe for ships.



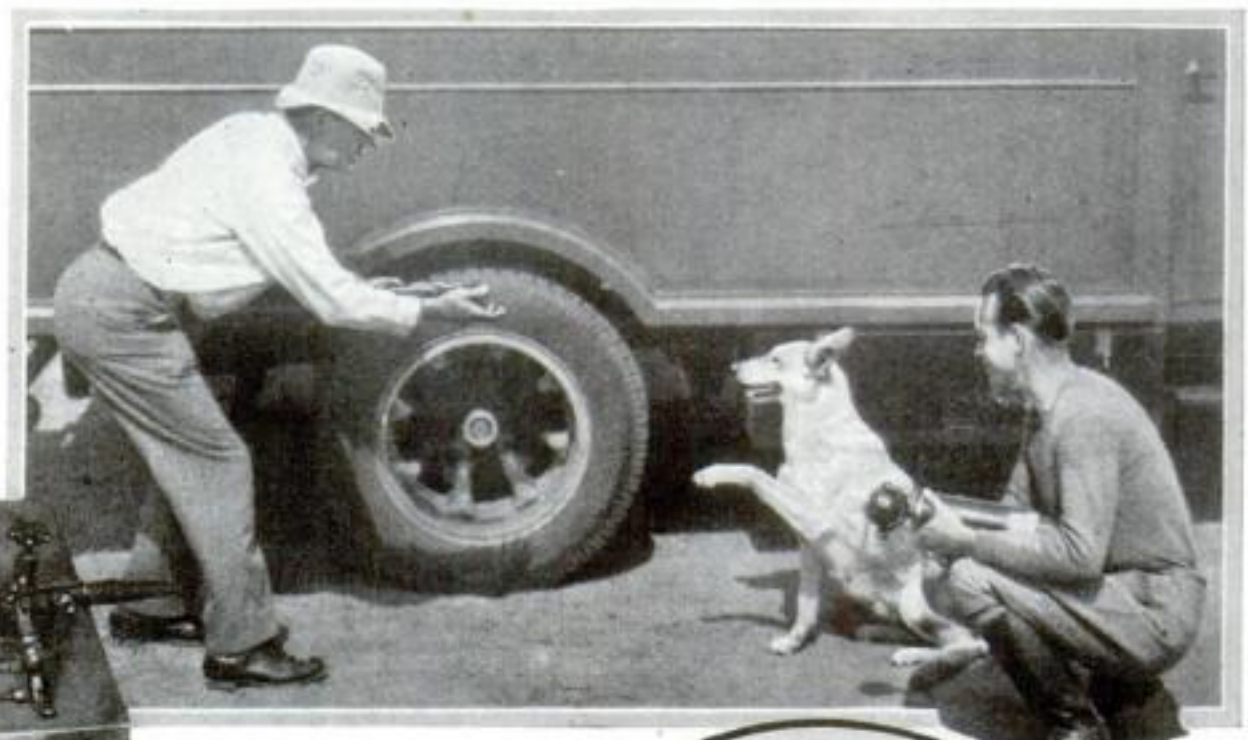
Above, the lighthouse tender has just made fast to this giant sea buoy preparatory to placing full tanks of gas inside it. At left, removing empty gas tanks from a lighted buoy in midwinter, often a highly hazardous job



Above, daughter of the lighthouse keeper at Jupiter Inlet, Fla., replacing a 500-watt bulb. Note how small these powerful lights are. The prism-like lenses are seen in the background. At left, a big tank of compressed acetylene gas is being lowered into a lighted buoy. The tanks contain enough gas to keep the light going several months

Canning Nature's

Bernard Brown, sound expert, demonstrates the old way of getting train noises for the movies, with a mechanical device. Now the real noises are put on film and held in containers shown above



At top, Rin Tin Tin's mother doubles in noise for her famous son. In oval, recording smack of Bobby Jones's driver

IN TWO great steel and concrete vaults, cooled against the summer sun that shone down on Burbank, Calif., scores of round metal containers lined the shelves. There were cans of thunder and of falling rain; bumps, clicks, and crashes; rattlesnakes' ominous warnings; seals barking, auto tires singing, and waves slapping against bow and stern of ferryboats and ocean-going liners.

"How many feet of effects do you have?" I asked.

"Man," replied the sound assistant, "you're talking in millions now."

Five million feet of sound effects, nature's noises in the can, ready to be "mixed" with actors' dialogues and other sounds for the talking pictures.

Noise comes by the foot now. In the "old days" of sound, not yet four years distant, most of these effects were recorded in movie studios on wax records later to be synchronized with projection machines in theaters. Today in most theaters, the sound comes right along with the movie film, recorded as wavy lines alongside the picture.

When a director calls for a babbling brook, or footsteps starting on a carpet, moving across a wood porch, and leading down a gravel walk, sound effects men pull a can from the vault and hand him any footage he may desire.

In the various studios of Hollywood and New York many millions of feet of noises are stored away ready for use. Some technicians continue to "manufacture" sounds, such as ferry whistles and slamming doors, but the true noises produced by nature and her birds and beasts come to the screen via microphones sent out on sound trucks, equipped with recording cameras, to can the sounds at their sources.

Bernard Brown, who "manufactured" the first noises of a moving train ever used in the talkies, recently has ridden freight trains and steamships to put on film the sounds of cars bumping together, of steam hissing, of waves slapping against a boat. He has sat the night out in the midst of thunderstorms waiting for the "perfect peal," has waited hours for a canary to sing, and has transformed the babbling of a brook into roaring ocean breakers!

Recently he loaded a sound truck on the *Emma Alexander,* San Francisco-bound from Los Angeles, and in one night canned several thousand feet of wave-slapping from different parts of the boat; of the engines singing their song of power; of distress whistles and other sounds at sea.

"We took the mike below," Brown explained, "and recorded waves through portholes. They sound differently there from the way they do on deck. Through a side of the ship, they give out a hollow, metallic noise.

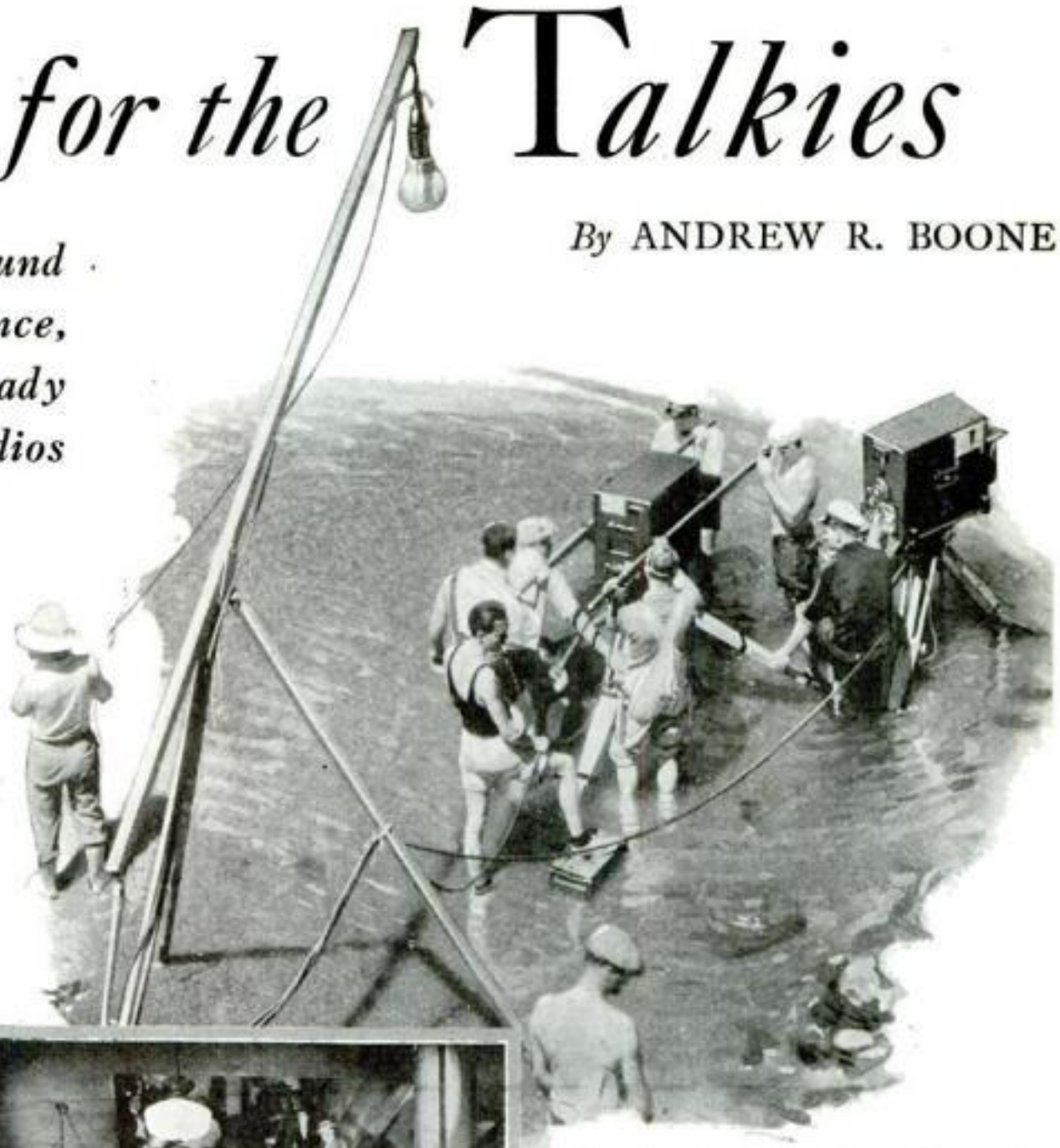
"By manipulating the 'gain,' or the power poured into the apparatus, we turned the sounds of a normal voyage into storm effects of varying intensity. Already the footage ground out on this trip has been turned into storms for several pictures."

ON SAN FRANCISCO BAY Brown has recorded the sounds of local boats. Side-wheelers, tugs, steam plants, Diesel engines contributed to the talkies' realism. He set up his recording equipment on large yachts where the pounding effect of water comes in larger volume than on smaller boats. Later these noises may be used in conjunction with pictures showing any types of boats used on lakes and rivers or at seaports.

Noises *for the* Talkies

By ANDREW R. BOONE

This Article Tells How Sound Films, Made Far in Advance, Are Held in Storage Ready for Use by the Picture Studios



The microphone suspended from the pole in the foreground gets the swish of the water and the familiar sounds of a bathing beach

Along the San Francisco water front, at three A.M., he has set up in several locations to record boat whistles coming from distant ferries and liners returning from the Orient. Even the little lapping of the water on the piling of the docks entered his microphone to be canned for a picture filmed several months later in which the lapping and weird whistles that had been caught by the sound film contributed an eerie effect to a suicide on a fog-shrouded dock.

Even thunder, at $2,000 a foot, is filed in the sound library. In a single storm, Brown shot 12,000 feet of film and got nothing, for the thunder refused to roar. Twenty-five miles of film have been exposed to storms for the single good peal of thunder recorded on a twenty-foot strip of film which is filed in Brown's vault for safe keeping.

When the bang and racket of an escalator was wanted, a microphone, carried to the machine, recorded the real sounds

This rattlesnake, securely bound, was teased with a stick until it made its characteristic sound which the near-by mike picked up for future use in some western thriller

"Thunder is, as you might guess, one of the most difficult sounds we have tried to catch," Brown said. "In recording thunder, the sound truck is sent to some location where reverberation will not interfere. Throughout the thunder period the film must be kept going, for we can't get the machine up to speed in time if we wait for the first rumble.

"Naturally we have no time for rehearsal with thunder. We have been out on thunder location fifteen times and still have only one good, deep, roaring peal. This has been used with varying intensities in fifty pictures! Undoubtedly the same peal has thundered several hundred times in these pictures.

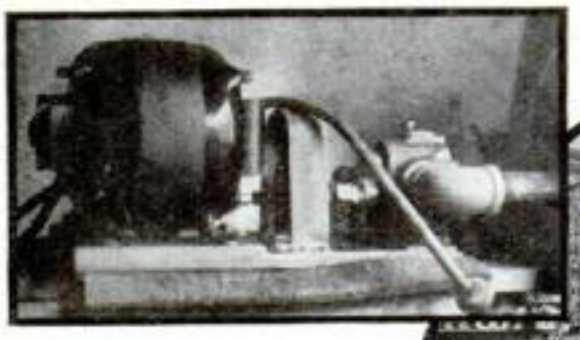
"To get the thunder, we placed the microphone under a roof to shelter it from wind and rain. Our worst trouble, in addition to our frequent failure to get thunder, are the birds. It sounds funny to hear a bird sing as thunder roars, but we frequently got just that."

FROM thunder to the rattle of a freight train is not a long step, and after getting the heavenly bombardment, Brown lashed a sound truck to a flat car and went from Los Angeles to San Bernardino. Cables were strung over box cars back to the caboose and forward to the engine tender and the cab. The clickety, click, click; the bumps of starting and stopping; the whistle and the bell as the train pounded along, found their places on celluloid.

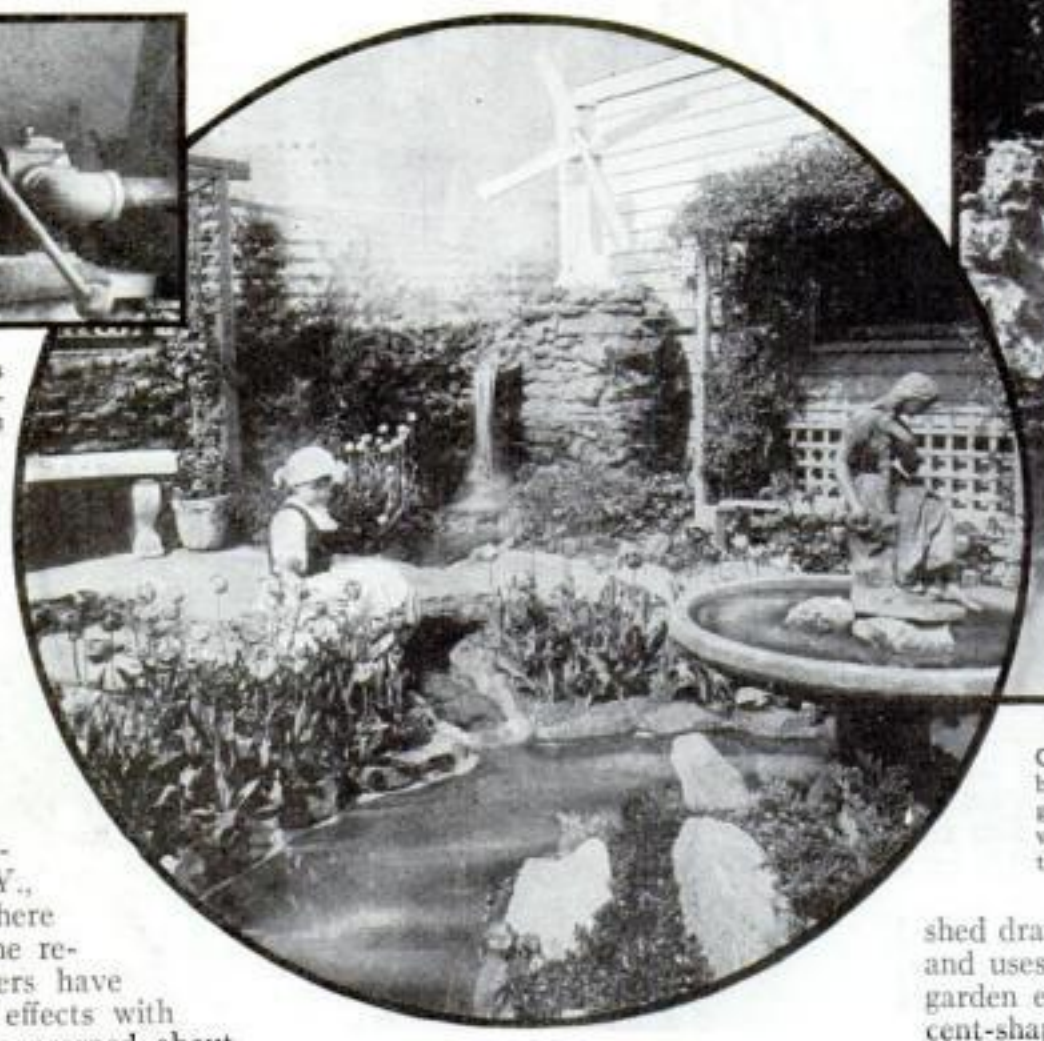
On another trip, he took passage with his crew on a passenger train from Los Angeles to Santa Barbara, and several thousand feet of film caught the clean, swift sound of the limited as it sped northward.

The train carried him near a small stream, which reminded Brown of another assignment. From the studio a few days later he carried a recording camera to a brook at Lone Pine. Its tiny waterfall would be *(Continued on page 138)*

Sound Effects for Your Garden Are New Fad



This little motor pumps the water for an artificial cataract and stream



E. J. Rawleigh, of Kenmore, N. Y., has a splashing cascade and a lapping brook in his front yard made to his specifications

Carefully chosen rocks were arranged by Carl Mehling, Kenmore, N. Y., to give the sound effect of a woodland waterfall when a stream rushes over them, as shown in the photo above

Now every garden may have its appropriate sound effects. If you crave the roar of a waterfall in your back yard plot of flowers, that is easy and relatively inexpensive to provide. Or, if you wish, you may have a brook that babbles, murmurs, or tinkles. According to a Kenmore, N. Y., rock garden specialist, there is no guesswork about the results. Some home owners have even worked out sound effects with blueprints, as anxiously concerned about acoustics as any Hollywood talkie director. The rate of water flow, the height of its drop, and the shape of stones it strikes determine what the listener will hear. For example, one Kenmore home owner wanted to give visitors to his garden the impression of being near a waterfall in the woods. Beside a small oval pool, a four-foot-high pile of stones was built up under the specialist's advice. Rocks as irregular as possible were chosen, with several flat ones jutting out where water would strike them. When a torrent of 2,500 gallons an hour gushed from concealed pipes in the rock pile, the illusion of a distant waterfall was perfect. A quarter-horsepower electric pump in a tiny shed draws the water from the pool itself and uses it over and over again. Another garden enthusiast added sound to a crescent-shaped lily pool behind his home by leading to it a pipe from his household water supply. Water trickles from this pipe down to the pool through a channel, in rocks arranged to produce a tinkling sound in keeping with the delicacy of the garden. More or less robust sound effects are produced by varying the size of the water pump, and altering the channel. One handy man used a household motor with a small pump to provide his stream. It splashes down a large mound of stones in a corner of his garden, beneath a home-made windmill, beyond which it forms a gently lapping brook. An unlimited variety of sound effects is possible by varying such an arrangement, and many small and inexpensive water pumps are now on the market for use with fractional-horsepower electric motors.

At top, kelp, a kind of giant seaweed, is harvested to make bread as shown above

SEAWEED BREAD ADDED TO HUMAN DIET

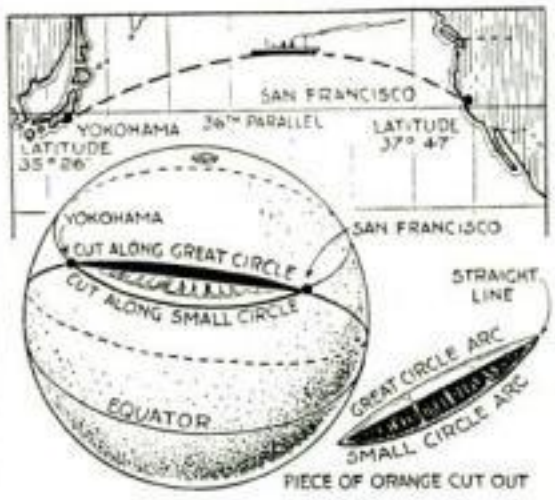
"Seaweed bread" has just made its appearance on the Pacific coast. Made from the giant kelp plants that grow fifty feet long in beds along the California coast, and recently introduced for the first time upon a commercial scale, it contains iodine and a number of other minerals declared to be useful in correcting diet deficiencies. Its odd flavor is said not to be disagreeable. Previously seaweed has been used for feeding cattle, and laboratory experiments have been made with a seaweed diet for white rats.

COIN-IN-THE-SLOT ICE VENDOR NOW IN USE

If a cake of ice is needed unexpectedly, or at unaccustomed hours, this new self-service dispenser saves a hunt for the neighborhood ice man. When the customer drops fifteen cents in the slots, out comes a twenty-five-pound cake of ice wrapped and ready to take home. Several of these automatic vendors have been erected on conspicuous corners in Los Angeles, Calif. The containers are heavily insulated to maintain refrigeration and prevent melting of the ice.

Fifteen cents dropped in the slots of this vendor gets a twenty-five-pound cake of ice

Five Minutes of ASTRONOMY



SHIPS STEAM NORTH TO SAVE MILEAGE

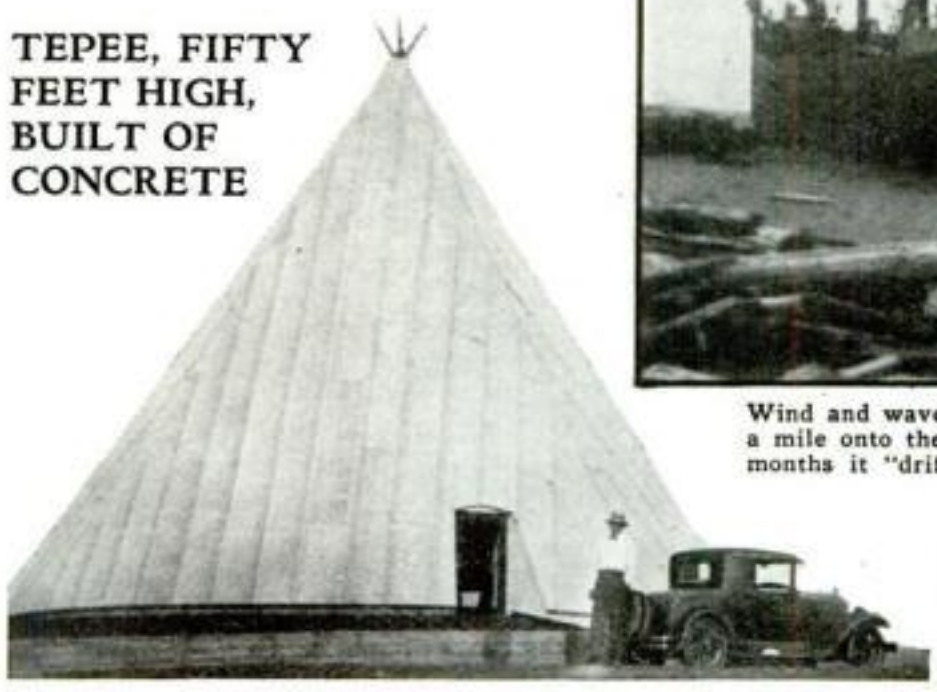
IF YOU are a passenger on a steamer sailing between San Francisco and Yokohama, Japan, you may be surprised to see that the course of the ship on the chart is not straight west, although San Francisco and Japan are joined by almost the same parallel of latitude. Instead, the captain lays a course to the north, eventually returning south to his destination. A simple experiment with an orange will show why the thirty-sixth parallel is not the shortest route. Let the stem end of the orange be the North Pole, the blossom end the South Pole, and the circumference halfway between the equator. Now mark a point for San Francisco about halfway between North Pole and equator, and another point for Yokohama at the same level, and a little over a quarter of the way around the orange to the left. Then start at the mark representing San Francisco to cut off the top of the orange, keeping the knife parallel to the equator and stopping the cut when the knife-edge reaches the Yokohama mark. Next start another cut, starting at San Francisco, with the edge of the knife directed this time toward the center of the orange and stop when you have cut through to Yokohama. Now lift out the wedge-shaped bit of orange and compare its two curved edges with its single straight edge. The straight edge represents the shortest possible distance from San Francisco to Yokohama. The curve representing a straight westward course along the thirty-sixth parallel is an arc of a "small circle" of the earth. The curve that was the result of a cut in the plane of the orange's center represents part of a "great circle" of the earth. Yet the arc of the larger circle deviates less from the straight line joining the ports and is therefore the course requiring the least mileage, time, and tons of coal. You can see why ships choose great-circle courses whenever possible.

SHIP HURLED ASHORE, SALVAGES ITSELF

AN ENGINEERS' report that it will cost $5,000,000 to build a jetty and preserve valuable fishing grounds at Ilwaco, Washington, is the recent sequel of the strange story of a ship that salvaged itself. In January, 1928, the windjammer *North Bend* met a terrific storm at the mouth of the Columbia River. The ship, hurled inland by wind and water, was beached on a sand spit half a mile inshore. Salvage efforts failed, and the ship remained where it was for months until, of its own accord, it began to move toward the sea. One day in April, 1929, the schooner again was afloat. Meanwhile the furrow she plowed on her seaward journey was widened by waves, and a rich seining ground ruined. Salmon fishermen complained and a recent Government survey was the result.

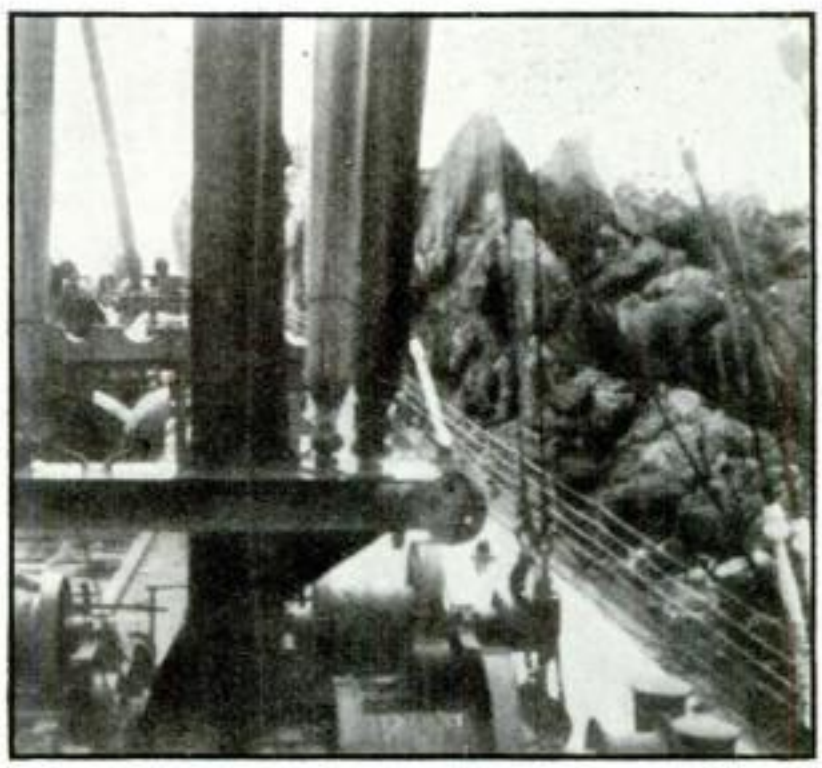
Wind and wave threw this ship half a mile onto the shore, but in fifteen months it "drifted" back to the sea

TEPEE, FIFTY FEET HIGH, BUILT OF CONCRETE



Built of concrete and steel on a hill near San Diego, Calif., this home is designed just like a real tepee

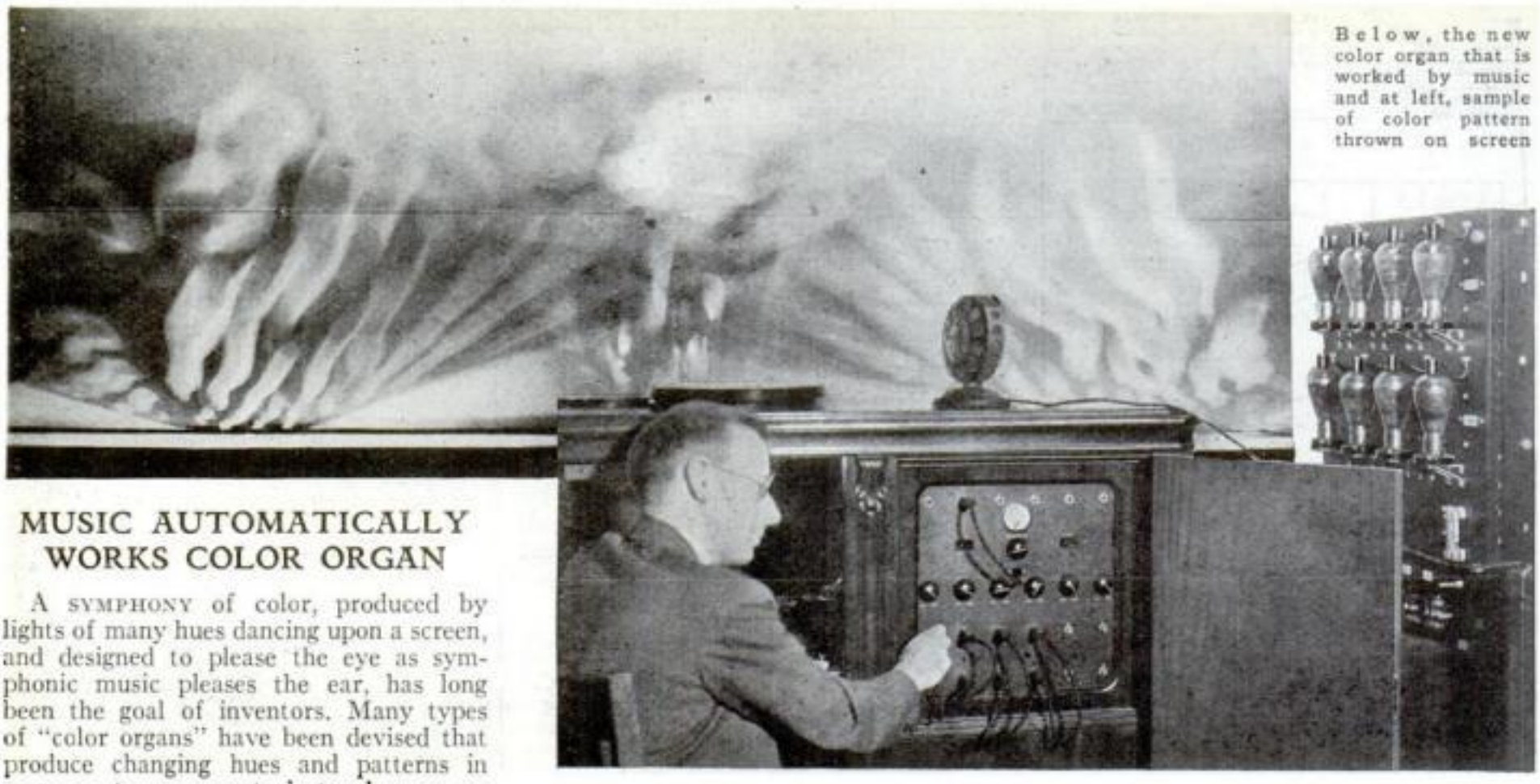
A CONCRETE "tepee" fifty feet high is the unique home that A. L. Houghtelin, retired sheep raiser, is building for himself atop a 1,000-foot hill near San Diego, Calif. According to its owner, its scientific design eliminates every cubic inch of waste space. Only its exterior suggests an Indian-style dwelling. Within, steel beams take the place of wooden boughs, and the walls are built up of composition, sheet iron, and cement. There are three stories, the first sixty feet in diameter. A chimney rises from the fireplace at the center to the peak of the tepee. Around it wind circular stairs to the upper floors. Sleeping quarters for Houghtelin and his son occupy the second floor, while the third floor has been made into a master's den. The concrete tepee has three doors of crystal glass with Indian designs upon them. As a boy, Houghtelin attended a school where many of the students were Indians, and became interested in their ideas on housing and living quarters.



Off the Brazilian coast are magnetic rocks that upset ship compasses and may have wrecked this American boat

MAGNETIC ROCKS WRECKED SHIP?

MAGNETIC boulders may have played a part in a recent shipwreck, when the American liner *Western World* went aground off Ponta do Boi, on the Brazilian coast. According to shipping men, the rocks exert a powerful magnetic attraction similar to that of the lodestone. While the force of attraction is not nearly enough to draw a ship upon the dangerous shoal, it is known sometimes to throw compasses of passing ships as much as ten points out of true. Thus a liner might lose its bearings and be swept on the rocks by an inshore current.



Below, the new color organ that is worked by music and at left, sample of color pattern thrown on screen

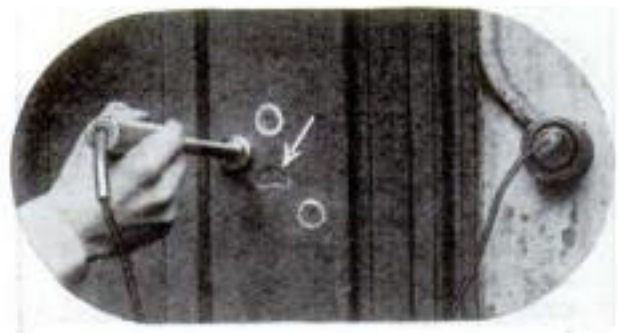
MUSIC AUTOMATICALLY WORKS COLOR ORGAN

A SYMPHONY of color, produced by lights of many hues dancing upon a screen, and designed to please the eye as symphonic music pleases the ear, has long been the goal of inventors. Many types of "color organs" have been devised that produce changing hues and patterns in response to an operator's touch upon an organlike keyboard, or from an automatic record. Now comes the first instrument that automatically turns music into color, picking out appropriate blends of hues to "accompany" an orchestral performance. This apparatus, know as "telecolor," is designed either for the home or theater, and is operated by music from radio, phonograph, or an actual orchestra. It consists of a cabinet resembling a radio set that controls a series of colored lights playing upon a screen. In the cabinet, electric "filter" circuits analyze the music into sounds of various pitch. A certain color is assigned to each pitch, and appears on the screen when such a note is heard. The inventor worked on the theory that each color corresponds to a certain mood; thus red is exciting, yellow is joyous, green is tranquil, blue is grave or serene, violet is solemn, and purple pompous and impressive. Assuming, for example, that the bass notes of a drum showed the desire of a composer to create a stirring, exciting effect, he assigned a red color to this sound. When quiet, tranquil music is played, green or blue predominates. Thus the listener's enjoyment is enhanced by a moving play of color designed to please the eye. Any type of light projector may be used in conjunction with the "telecolor" control such as illuminated advertising devices, according to Edward B. Patterson, Camden, N. J., radio engineer and inventor of the device. The telecolor instrument may also light fountains.

MILLIONS IN CASH FED TO FURNACE

WEAR and tear of constant usage does things to paper money. It can't last forever, and while it can be renewed by washing, there's a limit to that. At last it begins to fall to pieces and of course only the Government can destroy the worn remnants without incurring heavy loss. Bills of all denominations, no longer fit for public circulation, are turned in to the United States Bureau of Engraving and Printing and there they are destroyed. This destruction must be thorough. Two methods are used, as shown in the accompanying pictures. By one method, the money is reduced to pulp, and by the other it is burned in a furnace. $10,000,000,000 in paper money is thus destroyed each year.

Above, millions in money goes into pulp and, left, other millions burned



TAKE DENTS FROM WOOD WITH IRON AND STEAM

DENTS in your furniture, like wrinkles in clothes, can now be removed by a simple process developed by Walter Kuchany of Berlin, Germany. An iron, that somewhat resembles a soldering iron, is the main tool in this scheme of repairing wood. In removing a dent, moisture is spread over the injured spot and over this parchment paper is placed. The heated iron is then applied to the paper immediately over the dent. The moisture, thus converted into steam, rises against the iron, expanding and pulling up the sunken fibers of the wood.

894 PLANES IN AIR WAR

EIGHT hundred and ninety-four planes of the Italian army and navy participated in a recent mimic air war at Rome, making it the greatest aerial demonstration ever staged. When U. S. Army Air Corps flyers carried out sham attacks last spring, their fleet totaled less than 700 planes.

AMERICAN RADIO AMATEURS AID ASIATIC EXPEDITION

Above, one of the tractor cars that is traveling a trackless route through Asia, and, right, radio amateur who listens nightly for report of exploring party

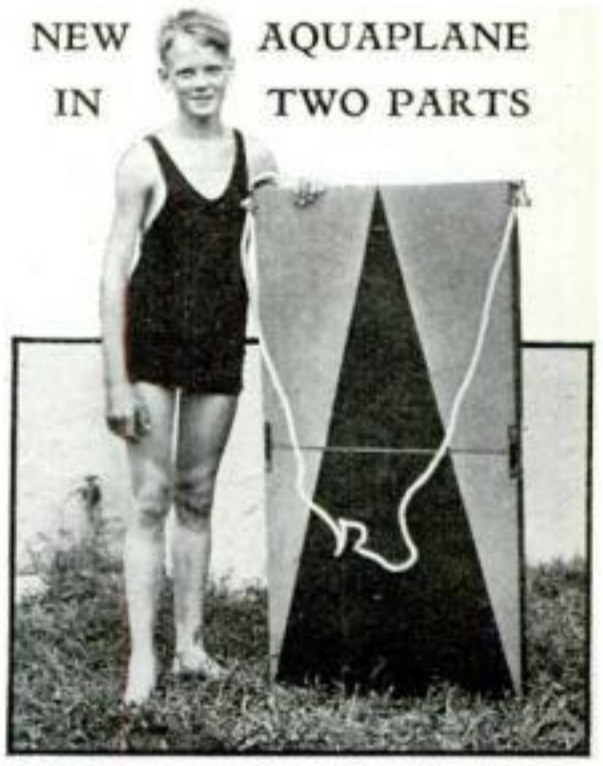
WHILE tractor cars of the Haardt Trans-Asiatic Expedition are fighting their way through trackless mountain passes of Asia, news of their progress is flashed to the world by the most elaborate amateur radio chain ever set up to aid science. A radio transmitter on one of the exploring cars reports to headquarters at Beyrouth, Syria, whence the messages are relayed to the United States at six o'clock every evening. About 150 American radio amateurs are listening for them, working under the supervision of the American Radio Relay League, an amateur organization. If heard in Washington, the communications are telephoned immediately to the National Geographic Society. Should atmospherics interfere, radio "hams" in other cities relay the messages to Washington. A recent report told how two of the cars had to be taken apart and carried over a pass blocked by a landslide.

SIXTY-FOOT ELEVATOR IS PORTABLE

Above, Uuno E. Tuomi, of Dallas, Texas, with his portable elevator which is only five feet high but can be extended, as at right, to sixty feet

LIFE-SAVING, easily portable, is the elevator invented by Uuno E. Tuomi, carpenter of Dallas, Texas. Tuomi's device, which can be carried with ease on a small truck, is only five feet in height when collapsed but it will expand to sixty feet—high enough to reach to a fifth or sixth story window. The platform is raised on threaded shafts, turned by an electric motor. An ingenious feature is a set of guy wires, automatically tightened so that they brace and steady the platform when in its elevated position. According to the inventor, the elevator is intended not only for rescue work, but for use wherever there is need for a temporary scaffold. The photographs at the left show the apparatus folded and extended to full height, together with its inventor.

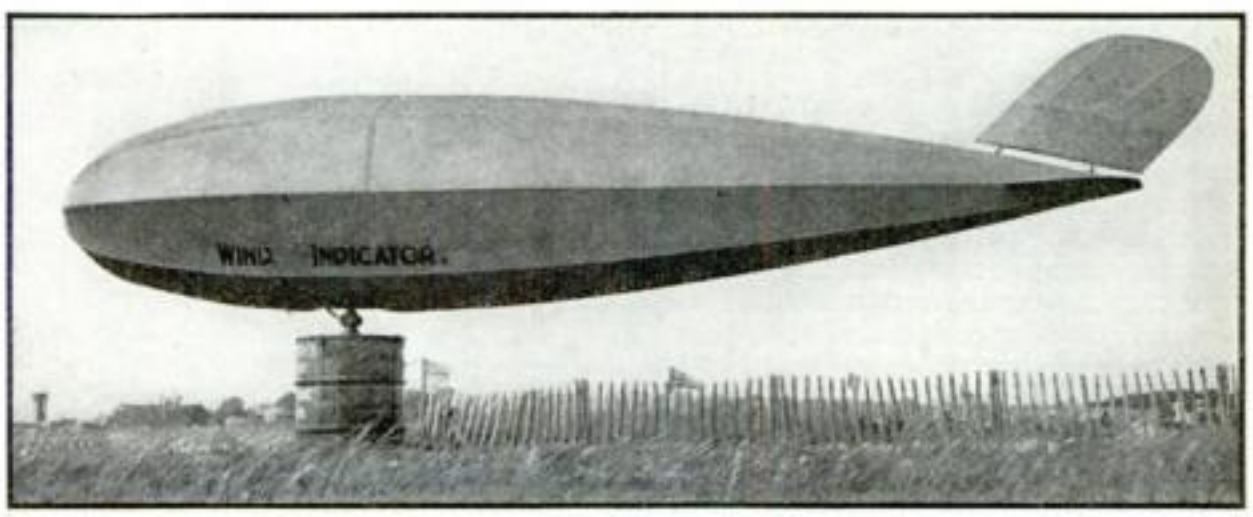
NEW AQUAPLANE IN TWO PARTS

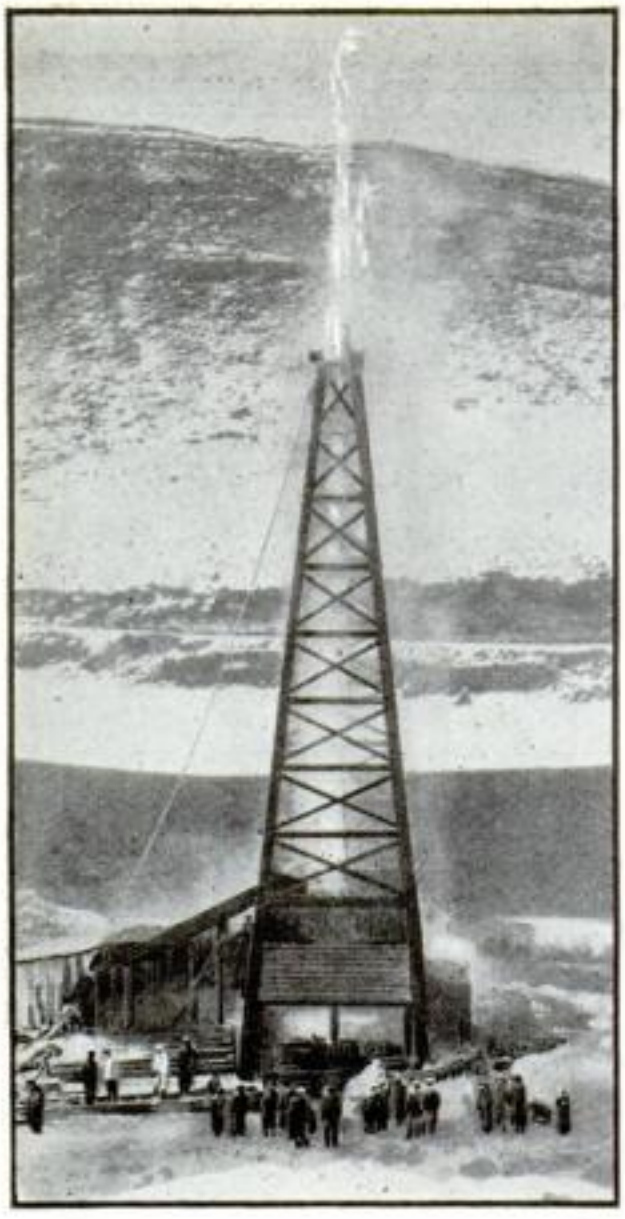


YOU can take your own aquaplane with you when you set out for a southern vacation this winter. A portable aquaplane, capable of supporting a man weighing 200 pounds, is now available. It consists of two pieces clamped together with turnbuckle bolts. The two hollow parts come strapped together with a carrying handle and turnbuckles and tightening wrench.

NEW WIND INDICATOR SHAPED LIKE AIRSHIP

HIGH flying planes easily get the wind direction, when they want to land, from a gigantic indicator shaped like an airship and recently put into use at the Heston airdrome, England. The indicator is balanced on a pivot joint and its great, flat tail keeps its nose constantly to the wind. Painted a light shade on top, it is plainly visible to pilots and removes all doubt as to the wind direction and the manner in which a landing must be made in order to avoid a "crack-up."





WELL DRILLED FOR OIL SPOUTS "DRY ICE"

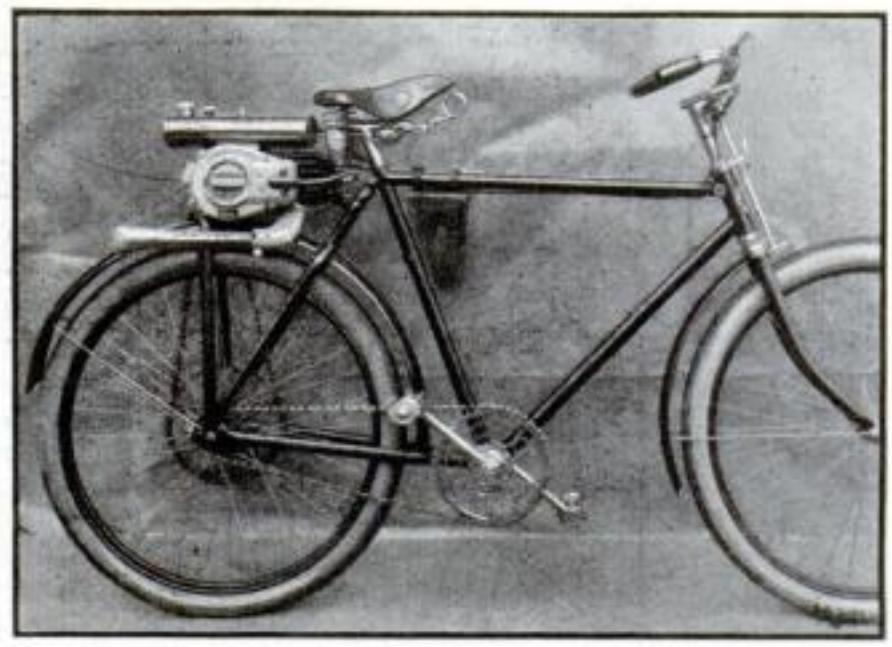
AN OIL man sinking a well for petroleum near Delta, Colo., received a surprise when the drill tapped a great underground store of carbon dioxide gas instead. The unexpected find was a lucky one, however. With the installation of compressing machinery, the gas is now solidified by pressure and chilling into the "dry ice" of commerce, and the well's output is about sixty tons of the refrigerant daily. While many other wells are now producing dry ice, few have been discovered in this accidental fashion. So nearly pure is the dry ice from this particular shaft, according to its owner, that a chunk of the snowy substance may be dropped into a glass of water to produce a bubbling, carbonated beverage at home without the addition of any other ingredient except that of the desired flavoring.

SHIELDS ON NEW AUTO HEADLIGHTS END GLARE

ONE of the strangest appearing cars to be seen on the highways of Massachusetts is that driven by Frank R. Dudley, Boston inventor. Its lines are altered by a pair of enormous headlights which Dudley has designed. Because of their odd shape, he says, glare is entirely eliminated. The bulky sheathing serves to confine the beam to the road just ahead. Dudley is trying to get state motor officials to recommend the use of his device.

Frank R. Dudley and car equipped with his shielded headlights to end glare

BICYCLE MOTOR FITS BEHIND SADDLE



DESIGNED to be installed behind the saddle, a new motor attachment for bicycles has been introduced in Germany. Because of its unusual position, the rider is protected from spattering oil and the noise of the exhaust is minimized. Power is transmitted to the bicycle's rear wheel through a chain drive and a gear fixed upon the hub. Except for a control lever it is entirely self-contained.

ONE FINGER PLAYS ONE-STRING "VIO"

A MUSICAL instrument called the "vio," just placed on the market, requires only one finger to play. Notes are formed by pressing the single string down upon a taut, narrow keyboard running from one end of the bowlike frame to the oblong sounding box, and then sawing the string with a violin bow. The range is larger than that of a violin string. According to the Hollywood, Calif., designer of the "vio" it is surprisingly easy to learn to play the vio. Several of them are in use in Los Angeles schools.

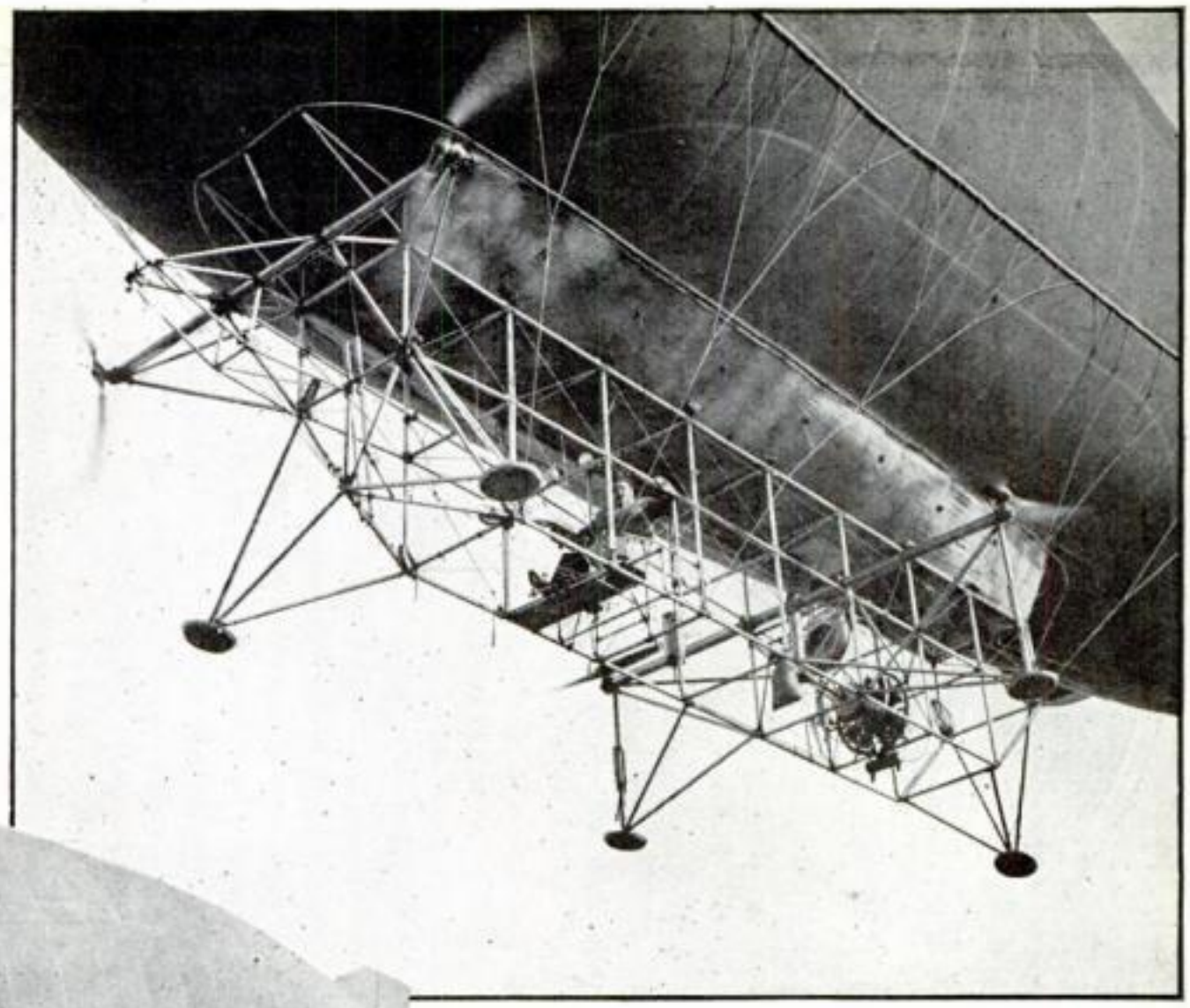
BUILD MODEL SHIP TO SAVE APPLES

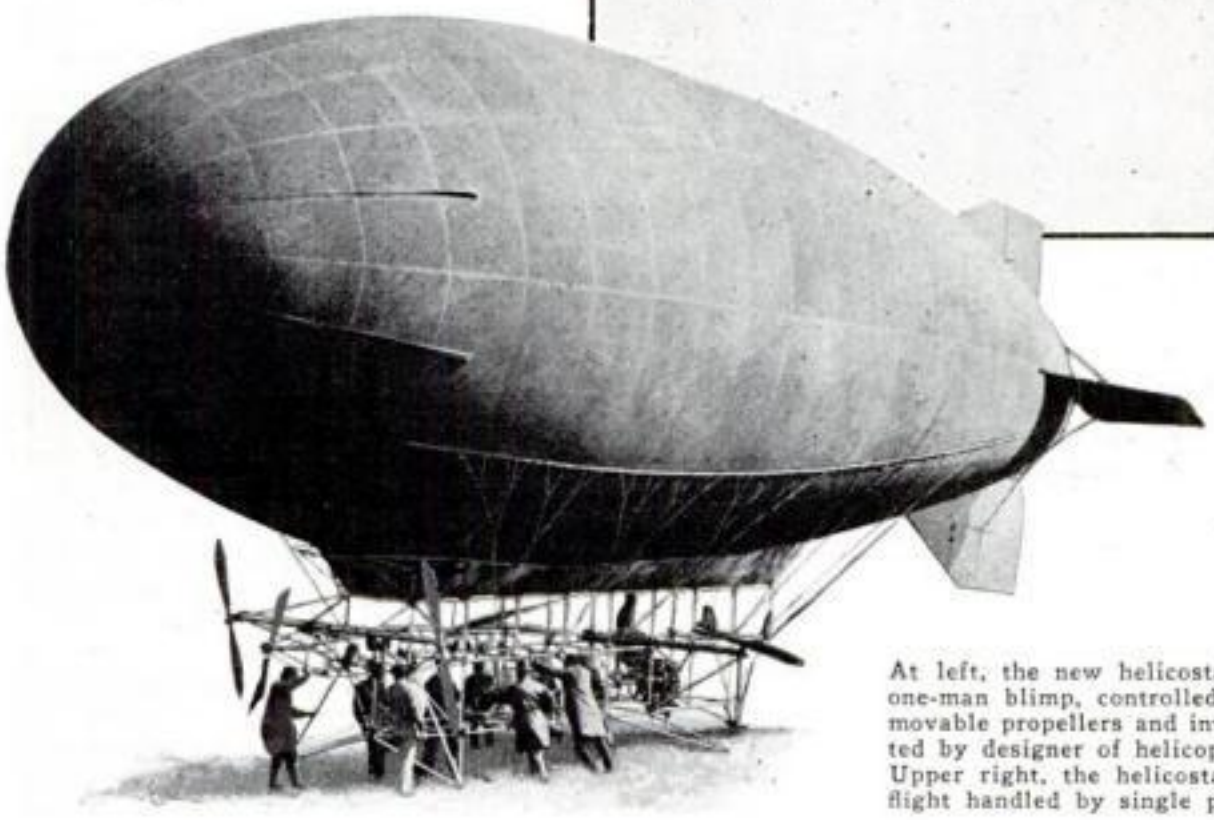
IN AN attempt to find out why fruit decays on the voyage from Australia to England, and to discover a way to end this loss, experts of the British government's Fruit Research Station built a "land fruit ship." This model reproduces conditions on a fruit freighter. Cases of apples are placed within the "hold" and thermometers indicate, in a laboratory overhead, the temperature in each case. Thus the scientists will determine the temperature at which the fruit is least likely to spoil while it is on its long voyage.

In this model hold of a fruit ship boxes of apples are placed in an effort to find shipping conditions that will keep them from decay

Helicopter Inventor Designs One-Man Blimp

A NEW type of lighter-than-air craft recently made its debut at the Orly air field, near Paris, France. Dubbed the "helicosta," it lands, maneuvers, and takes off without the aid of a ground crew, thanks to a set of propellers which may be turned in any direction. The inventor, F. Oehmichen, established his reputation as an aeronautical engineer by constructing a helicopter, or vertical-flying airplane, several years ago that in tests was able to rise from the ground. His new "helicosta" is a cross between this machine and a blimp.





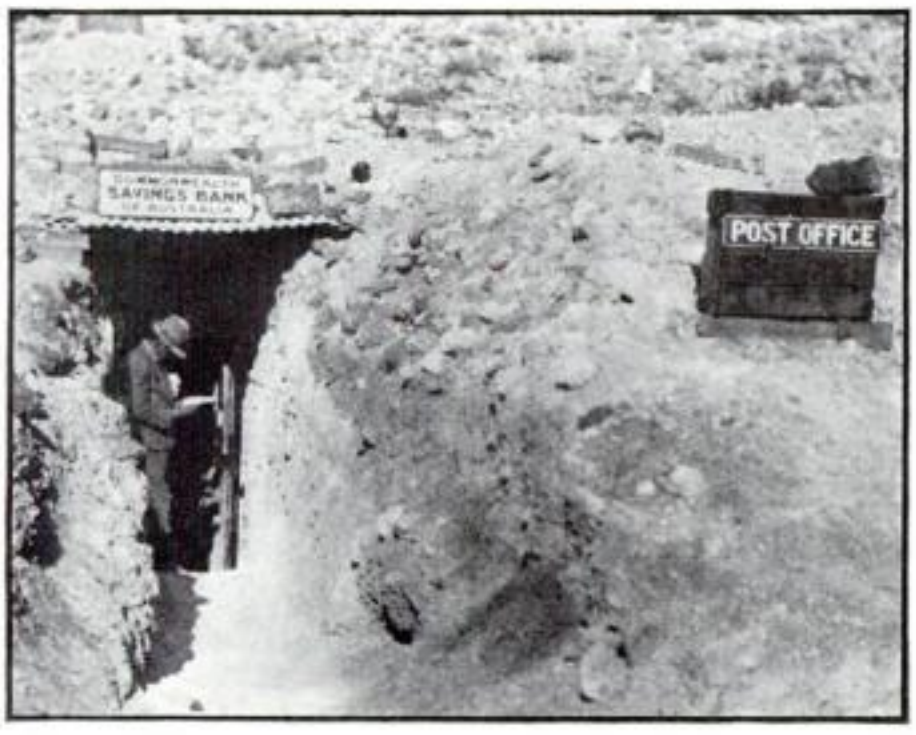
At left, the new helicosta, a one-man blimp, controlled by movable propellers and invented by designer of helicopter. Upper right, the helicosta in flight handled by single pilot

PHONOGRAPH RECORD'S CAPACITY DOUBLED

TWICE as much music can be put on a phonograph record as before, since the invention of a new process of "microchannel" recording that reduces the thickness of the wall between needle grooves. In this way a standard-sized disk can render a five-minute selection, or double the usual length. The process is to be applied in a flexible phonograph record that may be dropped or bent double without breaking, resembling in appearance a type already marketed at about one fourth the price of ordinary records.

OPAL MINERS HAVE UNDERGROUND CITY

MINERS of opals in the heart of Australia's "Never-Never" land have built themselves an underground city in which they take refuge from the sun's fierce heat. Believed without a counterpart in the world, this strange metropolis is a labyrinth of underground passages and dugouts where the miners make their homes. Even the city's bank, which is combined with the post office, is an excavation in the earth. A young girl, the only woman in the colony of 150 men of many different nationalities, presides over the subterranean store where the miners buy their meat and other provisions. Every Saturday a motor truck arrives, its motor usually steaming after the trip under the hot sun, with mail and provisions for the members of the little colony.



MICROPHONE IN LAPEL MOVES WITH SPEAKER

LAST month POPULAR SCIENCE MONTHLY announced the invention of a "buttonhole microphone" for public speakers. The accompanying photographs give an idea of how the new device works. The microphone, worn in the lapel, picks up the speaker's voice perfectly wherever he may be upon a stage. A trailing pair of wires connects the microphone to a public address system of loudspeakers.

Americans Invade Jungle

Pictures Tell Story of Hazards and Hardships Engineers Faced in Making Survey of Nicaragua

These cylinders of rock gave the American Army engineers a clear picture of the underlying geologic conditions in Nicaragua. A diamond core drill bored them out and a study of them shows the expert whether the deep-lying rock is a suitable foundation for dams and locks on the proposed canal route through the jungle

WHEN U. S. Army engineers who have been surveying a proposed transoceanic canal route in Nicaragua make their report to Congress next month, it will be known whether Uncle Sam is going to build a waterway even greater than the "big ditch" at Panama. For many months engineers battled man-eating sharks, tropical heat, and the sunless tangles of impenetrable jungles to find out if a ship canal can be built from coast to coast, and how much it will cost. The striking photographs reproduced on these pages tell more vividly than words the story of their experiences. Just what their recommendations will be has not yet been made public. Three alternatives have been under consideration—building the Nicaragua canal, enlarging the Panama Canal by adding locks, or making a sea-level waterway out of it. If the Nicaragua Canal is to be built, it is expected to take the route shown in map above.

The cylinders of rock shown in circle were made with the diamond core drill, above, set up in the heart of the wilderness. At right, clearing a channel with pontoon boat on Descado River

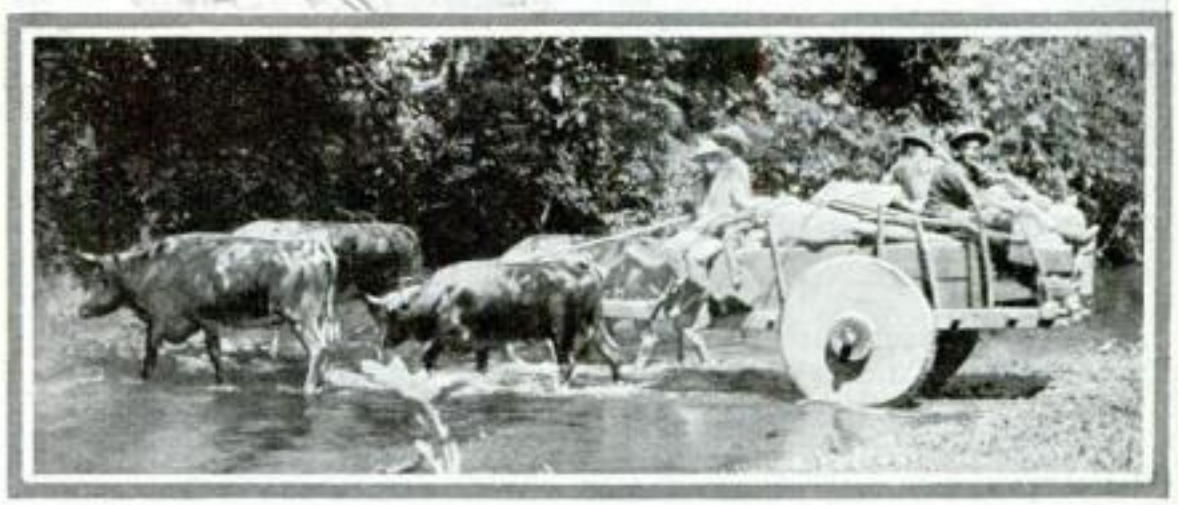
to Map New Canal Route

At the Atlantic end of the proposed Nicaragua canal route, this automatic tide gage was set up. It records periodic rise and fall of water to give information of conditions at the entrance of canal

In the heart of the jungle an impassable chasm was crossed on this crude suspension bridge swung between tall trees on the edge of the abyss. In the jungle men became white from lack of sunlight that seldom pierces the shades

Right, an outboard motor is pressed into service to pump water to one of the engineers' camps. Below, Zaperto Island, Lake Nicaragua, gave up this strange dog-faced idol, believed the prehistoric work of vanished Mayans

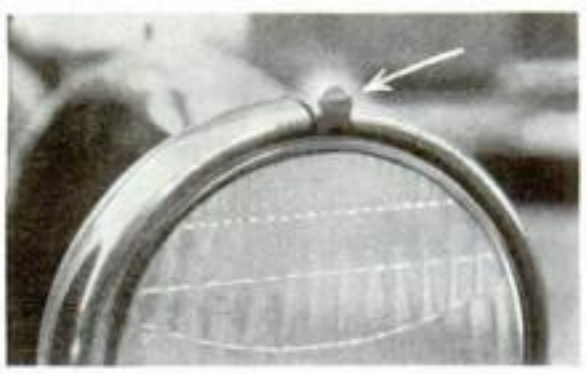
This evaporation gage had to be put under guard to keep native women from using water to sprinkle clothes



In parts of Nicaragua supplies for the men were secured with greatest difficulty. It was necessary to use primitive oxcarts to haul food and equipment to the camps far inland

STORY OF FIRST PHONE PUT ON SOUND FILM

"MR. WATSON, come here. I want you!" Spoken by Alexander Graham Bell, one June day in 1875, these historic words were the first ever carried over a telephone. The other day they were heard again when Thomas A. Watson, Bell's assistant, retold the dramatic story of the invention of the telephone, in the Bell Telephone Laboratories' sound picture studio. The unusual film demonstrates how modern apparatus can record for the benefit of posterity the history of great inventions as told by principals in the story. Using reproductions of historic instruments from the Laboratories' museum, Watson related how Bell and he worked out the first successful model. All instruments used in that first telephonic attempt fifty-six years ago were built by Watson from plans outlined by Bell.



CLIP TELLS CAR DRIVER WHEN HEADLIGHT FAILS

AN INCONSPICUOUS attachment for an automobile headlight now tells the motorist whether the bulb is burning properly. The telltale, a metal clip of polished stainless steel, snaps over the headlight rim. Its curved back reflects a spot of light when the lamp is on, thus averting the possibility of driving with one light out, incurring risk of a fine by a traffic officer.

OPEN OFFICE FOR JAPANESE TELEGRAMS

To SERVE the 20,000 Japanese residents of Los Angeles, Calif., the country's first telegraph office especially equipped to handle messages in that language was recently opened. Its employees are all American-born Japanese who can talk with patrons in their own tongue. Because Japanese characters cannot be transmitted by telegraphic code, the messages are dispatched as "photograms," by exactly the same process now used in sending pictures by wire. The addressee thus receives an exact photographic copy of the original message. This system does away with any possibility of garbled messages and communications that have lost their meaning by translation into English. Non-English-speaking Japanese find the new service a boon in communicating with acquaintances, and Japanese business houses in Los Angeles use the service in their transactions with firms in Japan. The insert shows a typical message from a Los Angeles Japanese to a friend in Japan.

America's first Japanese telegraph office seen above; and below, message as received to be transmitted to Yokohama

A glass shield covers this typewriter, thus making it noiseless and shutting out dust

SILENT TYPEWRITER HAS GLASS COVER

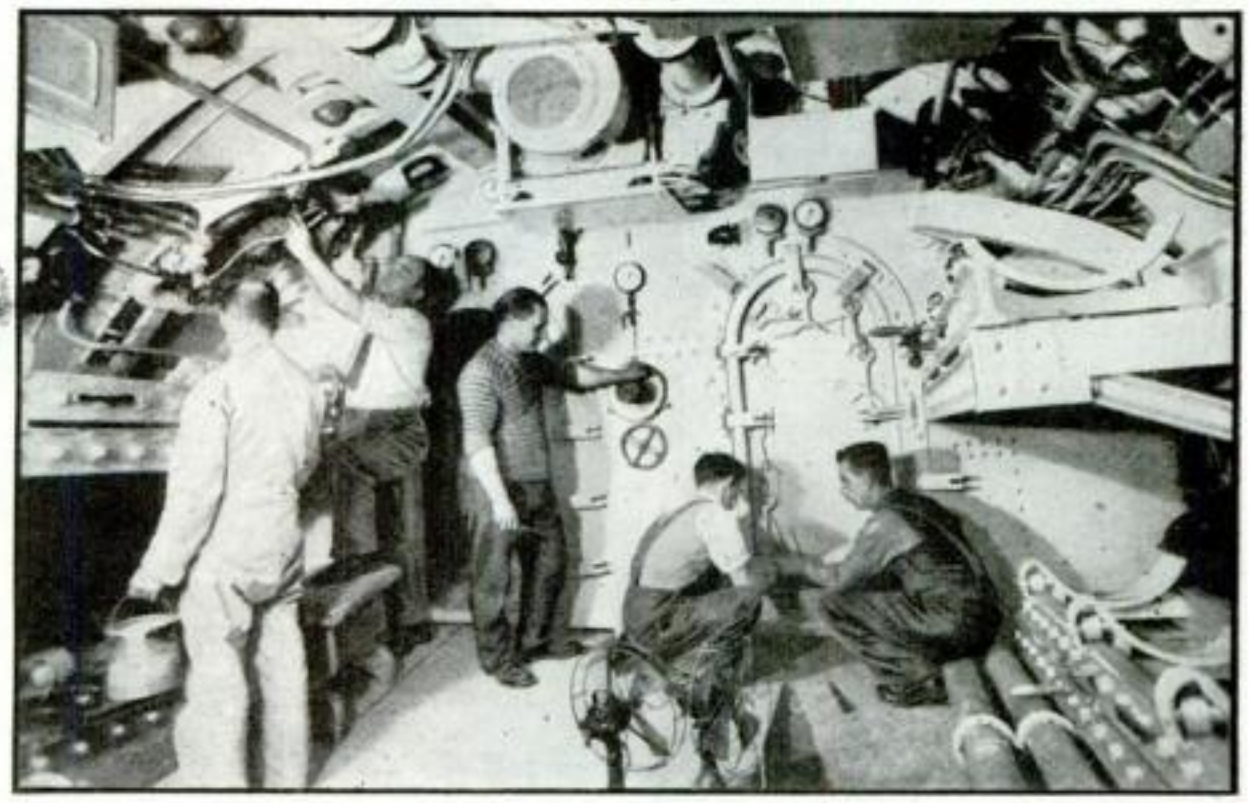
A TYPEWRITER working under glass to keep it noiseless was recently invented in Germany. Built into a special desk, it is completely inclosed while in use by a sliding glass cover. Lengthened keys protrude from slots at the front of the desk, giving it a piano-like appearance. When the typist wishes to insert or remove a piece of paper, she operates a foot pedal that pushes back the glass cover, as shown in the photograph. When the pedal is released, the cover automatically closes again. Besides being silenced, the machine is effectively protected from dust.

DRIVER NOW CONTROLS SHOCK ABSORBERS

ANOTHER knob for a car's dashboard has just appeared. By pushing it in or pulling it out a driver regulates hydraulic shock absorbers to give more or less play to the car's springs, according to the type of road and the car's speed. For high-speed driving in the country, the driver would set the control to prevent violent action of the springs. On paved city streets the adjustment is changed to give the springs more play. The lever alters the size of the aperture through which oil flows in the shock-absorbing cylinders.

Knob, indicated by arrow, controls action of car's shock absorbers to suit road conditions

Submarine of Wood Used to Film Sea Tragedy



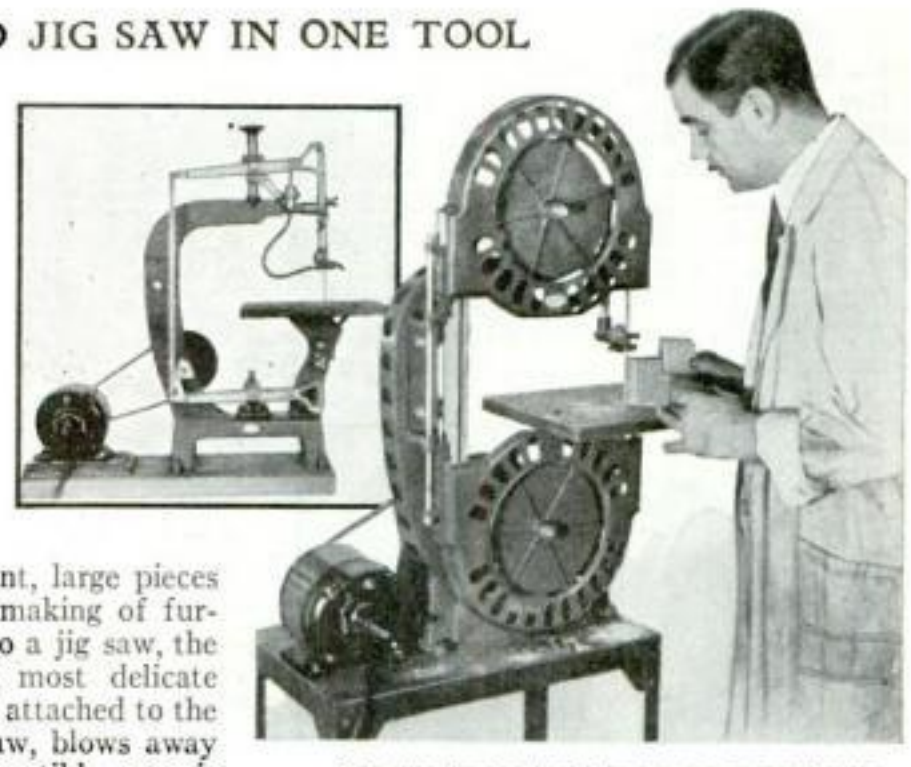
IT LOOKS like the real thing, but this interior of a submarine control tower, constructed in England, is made entirely of wood. It is an exact copy of the ill-fated British submarine *Poseidon*, complete even to instruments supplied by the British Admiralty. A motion picture company constructed the unusual model to reënact, for a film, the ramming and sinking of the *Poseidon* off the Chinese coast and the escape of part of its crew (P. S. M., Sept. '31, p. 29).

NEW LOOM WEAVES ARTIFICIAL FUR

ON A machine of special construction, Herbert J. Hope, veteran loom designer of Sanford, Me., has succeeded in his ten-year effort to create "man-made fur." His process weaves shorn mohair, the hair of the Angora goat, in such a way that long and short fibers are intermingled and held in a natural, erect position on a fabric base. The result is a shaggy artificial fur that resembles coonskin. The manufacture of plushes and other fabrics from mohair has long been possible but the problem Hope has just solved was the development of a loom that would handle long and short fibers at the same time. His success means that now instead of killing an animal and using its pelt, hair may be shorn and woven into synthetic fur. Moreover, this is "real" fur in a sense, since the fleece of the Angora goat has definite fur-like characteristics. Coloring processes have been developed to give the new fur suitable shades, and it is to be used in the manufacture of winter overcoats for men, women, and children. The photograph above shows Hope with a sample of his man-made fur, which has been named "koongora" from its coonlike appearance and its source, the Angora goat. Experts are now developing other furs woven from mohair.

BAND AND JIG SAW IN ONE TOOL

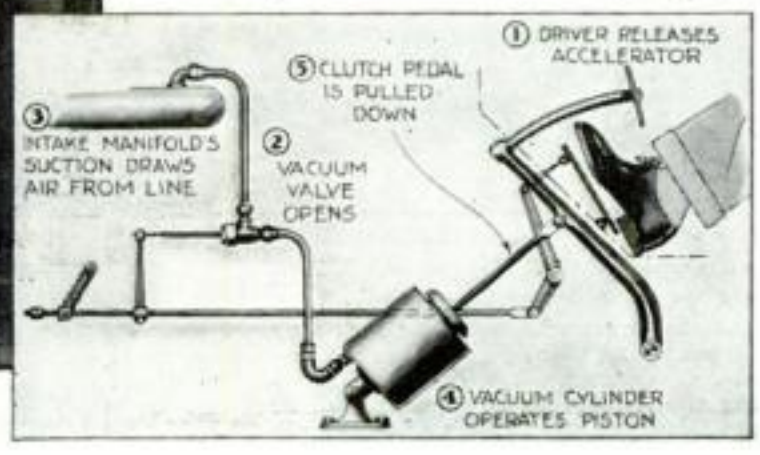
JIG SAW or band saw, a new convertible tool for the home workshopper, is transformed in a few minutes from one to the other by a few simple adjustments. The two-in-one saw enables a craftsman to perform heavy and light work on the same tool, at a saving to his purse. With the band saw attachment, large pieces may be cut, as in the making of furniture. Transformed into a jig saw, the tool will perform the most delicate scroll cutting. A blower, attached to the upper arm of the jig saw, blows away the sawdust. The convertible saw is driven by an electric motor.



The two-in-one tool in use as a band saw. Upper left, same tool turned into a jig saw

FOOT THROTTLE WORKS AUTOMATIC CLUTCH FOR CAR

A NEW automobile invention makes it unnecessary for the driver to touch the clutch pedal when he starts, stops, or shifts gears. The moment he lifts his foot from the "gas" pedal, the clutch is automatically disengaged, and reëngaged when the motorist steps on the gas. Any car driven with a foot throttle may be fitted with this new "automatic clutch control," which is said to reduce fatigue in driving, and to operate the clutch more efficiently. Its working parts are shown in the diagram at left. Releasing the accelerator opens a vacuum valve, allowing the intake manifold to create suction in a vacuum cylinder. A piston, or a flexible cable, in models for some cars, draws down the clutch pedal automatically. Depressing the gas pedal breaks the suction and the clutch is reëngaged.



Above, automatic clutch control, explained in diagram at the right

Holland Reclaims Land Under Zuyder Zee

The first flowers from the Zuyder Zee. They were grown on land lost by Holland when, five centuries ago, the sea swept in to form the Zuyder Zee which is now being reclaimed

Above, a portion of the Zuyder Zee inclosed by a dike with the pumping station at work. At right, reclaimed land and permanent drainage ditches

HOLLAND'S great inland sea, the Zuyder Zee, is being dried up. One of the greatest engineering projects ever attempted is winning from the sea an area of land two-thirds the size of Rhode Island. Work on the mighty undertaking was started five years ago, but it was only recently that the first large areas emerged from the water to be placed under cultivation. The plan being followed is to enclose a part of the water-covered area to be reclaimed with dikes. Then a pumping station returns the trapped water into the sea beyond. While the reclaimed land is still moist, steam shovels dig a network of permanent drainage ditches. When the fifteen-year project is completed, some 25,000 miles of ditches will have been dug—enough to encircle the earth. The photographs show successive steps in reclaiming a section of "polder" of land adjoining the "island" of Wieringen in the Zuyder Zee, which is now joined to the mainland, and also the first flowers raised upon the man-made land.

By the time that this issue is published, it is expected that the main dike across the mouth of the Zuyder Zee, from North Holland to Friesland, will be completed. Thus Holland will recover what she lost more than five centuries ago.

BARGE TAKES SMOKESTACK DOWN TO PASS BRIDGE

"Low bridge," the old cry of the inland waterways, will have an entirely new meaning for the captain of the barge Edgewater as it goes on its way between the Ford plants at Dearborn, Mich., and Edgewater, N. J. Bridge tenders will not be worried by the passing of the strange craft, but the crew of the barge will be on the lookout for low bridges and when one comes in sight motor operated machinery will be set going. As the wheels fly around, the smokestack of the barge will bend over and lie flat on the deck. Other high parts will do the same thing.

NEW ARMY RIFLE LOADS ITSELF

FASTER and more accurate shooting may follow the adoption by the American Army of a semiautomatic rifle, two different models of which are now being subjected to final tests. One of these is the invention of J. D. Pederson, inventor of the Remington pump shotgun, and the other is the work of John C. Garand who has designed many valuable models for the government. The advantage of the new rifle lies in the fact that part of the power of the gun is used to eject the empty shell and put a new cartridge in the firing chamber. With the present rifle this is done by hand, interfering both with speed and precision. The new arms are expected to be especially effective against enemy airplanes.

At top, the present U. S. Army rifle and below it the two models of the semiautomatic rifle, one of which may be put in use when final tests are completed. At right, arms expert studying the Army rifle now being used at the Government's Bureau of Standards

MOTORBOAT CAN TURN FLIP FLOP

ALMOST a submarine is an amazing upside-down motorboat built by Malcolm Pope, noted outboard racer. Driven at full speed, it is able to turn on its back and flip over again in a complete rolling somersault. The hull is of the latest racing design, powered by an outboard motor and capable of fifty miles an hour or better. Atop it Pope built a curved, streamlined housing, open at the back but otherwise perfectly water-tight. Heavy plate glass covers a semicircular window at the front. With this strange craft, he is learning new facts about hull design for racing outboards. Placing fins on the bottom of a racer has hitherto been done by trial and error, the error being noted when a racing boat capsizes at a turn because of the fin's wrong size or placing. Now Pope puts trial fins on his unique rolling boat and throws the steering wheel hard over while roaring at full speed through the water. If the fin is in the wrong place the boat does a complete somersault and lands safely on its flat bottom. His tests at Lake Manhassett, N. Y., show, he says, that a seventy-five mile speed is possible.

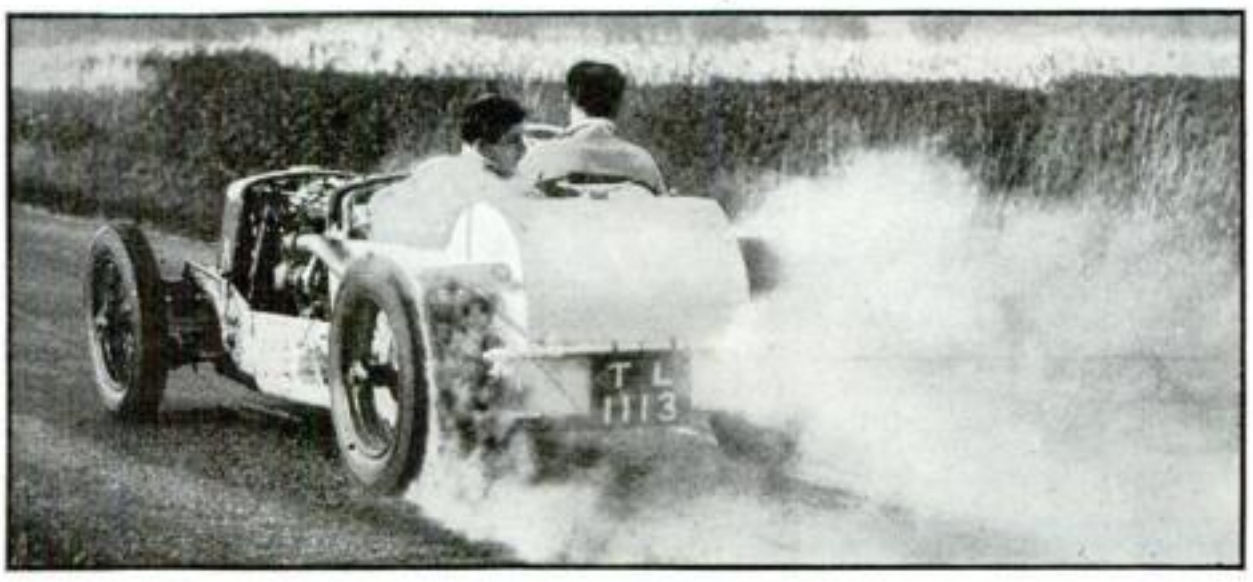
Above, motorboat turns somersault while running at full speed. Right, entering craft's water-tight compartment, seen below

PALM HIDES PROMPTER FOR PUBLIC SPEAKERS

NEARLY small enough to be concealed in the hand, a miniature prompter helps public speakers to recall the points of their addresses. Notes, typewritten upon a strip of paper, are revealed in the proper sequence while the speaker is talking. It was recently patented by a Pennsylvania railroad official.

CHANGE PLANE'S WING SIZE IN FLIGHT

A PLANE can change its wing spread in flight between thirty-six and sixty-eight feet by use of an invention of Ivan Makhonine, seen at right, Russian aviation engineer living in Paris. The larger span facilitates taking off with a heavy load, and landing at slow speed. Once in full flight, the pilot shortens the wing span to reduce air resistance.



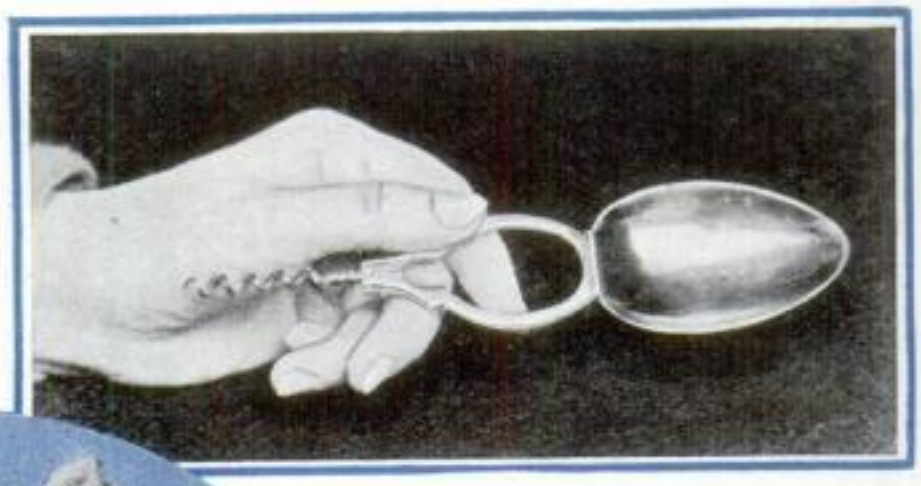
REAR WHEELS OF RACER RAISE SMOKE CLOUD

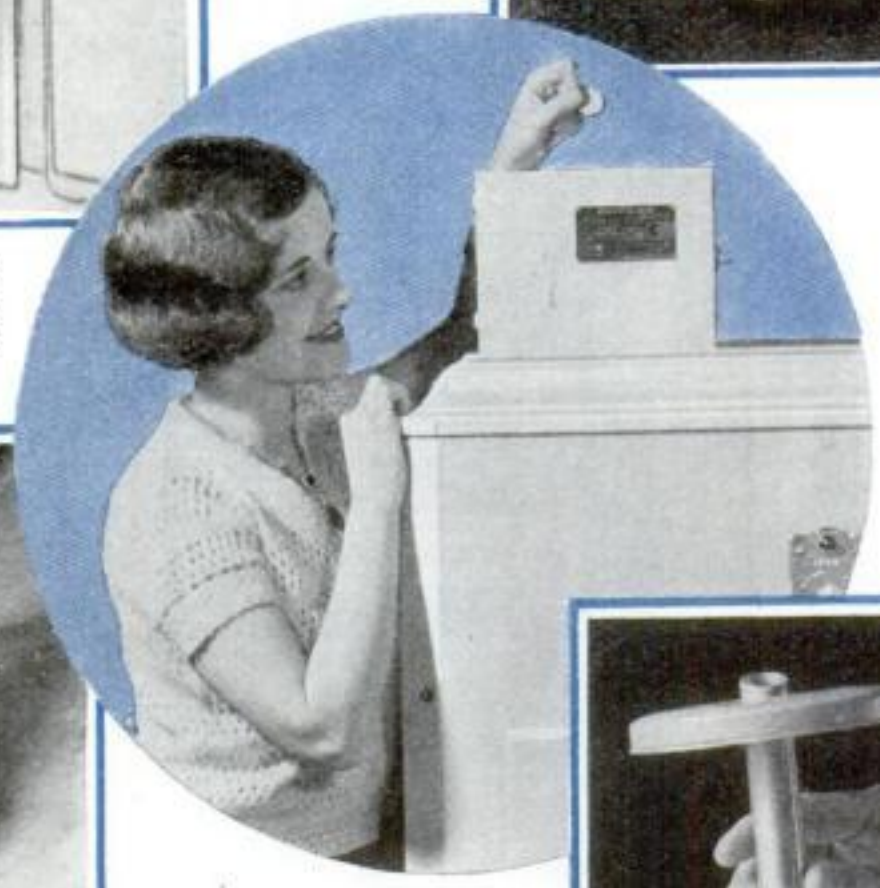
THIS unusual photograph of a racing car's tires burning and smoking, made during a cross-country race in England, presents an interesting picture puzzle. At first glance it looks as if the car were speeding. But closer inspection shows the front wheel standing still, and solves the mystery. Just as the camera clicked, the driver threw in his clutch for a quick start. As a result of the sudden application of power the back wheels spun around on the loose-surfaced road, generating enough heat to throw off smoke, making it look like a case of "burning up the road."

Latest Inventions for the Housewife

OPENS THE BOTTLE. A new attachment, standard on a make of mechanical icebox, is a bottle opener fastened to catch on refrigerator door

HAS TWO USES Folding into the handle of a device for travelers are a spoon and a corkscrew. When it is folded it makes a compact article so small it can easily slip into the toilet case





COIN RUNS ICE METER. This refrigerator for home use has a meter attached that operates the ice-making machine for twenty-four hours when a quarter is dropped into it exactly as the gas meters run by coins are worked

MEASURES YOUR COFFEE. In order to insure accuracy in making coffee the can, shown below, has a sort of false bottom that fills when the can is upright and is the only part of the contents that comes out the spout when the can is tipped up

THIS SCOURER UNWINDS. For use in cleaning pots and pans is a scourer that is formed of rubber wound around steel wool. As the wool wears rubber is unwound to release new surface

PRESERVES THE BEVERAGE. This metal cap snaps onto the top of a bottle and seals it as tightly as the original cap. With it, as shown, is also combined a decapper, thus always handy

FAN ON HEATER. To prevent cold air from settling on the floor while hot air rises to the ceiling this heater, left, has a fan that keeps air in circulation. Its fins also provide greater radiation surface and are said to reduce the cost of running the electric heater

LIGHT IS PART OF BRIDGE TABLE. A new folding table for cards has light firmly attached to it in such position that adequate illumination is afforded each player. Turning a thumbscrew permits the arms holding the lights to fold down against the bottom of the table, the legs of which also fold in so that device is fully collapsible

CABINET HOLDS HEATER. The radiolike device shown below is really an electric fan-operated heater designed for use in bathroom or nursery or wherever heat is desired. It can also be used as a hair drier or to warm a car's radiator

GOOSENECK SPOUT FOR SINK. No dish is so tall it will not fit beneath this curved spout which attaches to faucet in kitchen sink. The bend gives it a twelve-inch clearance above the bottom of sink so that even tall vases can easily be filled at it without tipping

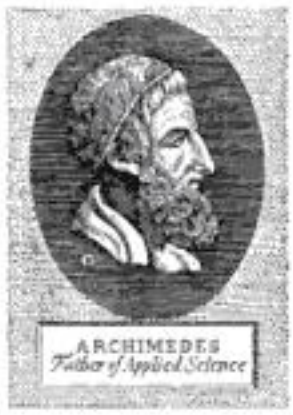
SEALS IN GLASS. At left is a cap that is designed to take the place of zinc metal porcelain cap generally used on jars of preserves. It has turned edges to prevent cuts

KNOB WORKS SCREEN. Pulling the knob on the window shown below opens the window and automatically brings a screen into place. Closing the window removes the weather-tight screen

CARRIES OFF ODORS. An electric blower in the stove dome seen at left creates a forced draft that carries out the flue all smoke and cooking odors. Inside the dome a light is installed that illuminates the stove's top

MONEY LOCKS THE WINDOW. At left is a window lock that is operated only by a coin either to lock or unlock it. It attaches with four screws and has only two parts. When unlocked the sash raises or lowers with ease

POPULAR SCIENCE
MONTHLY



RAYMOND J. BROWN, *Editor*
ARTHUR WAKELING, Home Workshop Editor
ALFRED P. LANE, Technical Editor
SYDNEY OXBERRY, Art Editor

Published Monthly by Popular Science Publishing Company, Inc., 381 Fourth Avenue, New York City. Single Copies Twenty-five Cents. In the United States and Its Possessions and in Canada, $2.50 the Year. In All Other Countries, $3.00 the Year.

Grain Rots and Men Starve

DEATH by starvation isn't news. People have been entering the Great Beyond by that portal ever since man's ancestors crawled out of the ooze and became human. It becomes news only when there is a famine that kills off large numbers of people. China, for example, makes the headlines when unnumbered thousands of poor Chinese cease eating because there is no food.

In this country, there has never been a food famine comparable to those that have afflicted China, Russia, and India. Our Pilgrim forefathers passed a hungry winter or two and there was a period following the Civil War when people in large areas of the South had a tough time getting enough to eat.

Those Early Panics

Today, the matter of starvation is again breaking into the news in connection with the world-wide economic depression. Owing to various social service agencies, only a small number of people actually have died in this country from starvation, but millions are living on short rations and may continue to do so for some time.

Early panics in America and the ensuing short-ration times were influenced in many cases by crop failures or were produced by the collapse of wild speculative booms that had, in the main, nothing to do with food supplies. Now we are faced with a situation almost unparalleled in history, a mountainous quantity of food on hand, still more in sight and yet millions of people going hungry!

On the one hand we have the spectacle of government agencies gravely proposing the deliberate destruction of one-third of the growing cotton crop and vastly curtailing the planting of wheat and on the other millions of people in distress because they haven't enough of these very commodities.

No wonder the average man is puzzled. No wonder he wants to know what is wrong when people are hungry and without adequate clothing or shelter in a land dotted with granaries filled to the bursting point, stores choked with stocks of clothing and building supply dealers with mountains of material on hand.

It is silly to say that science is to blame for this situation—that scientific methods have so increased production that there is an unusable surplus. So long as millions of people are in want, and therefore haven't the things they need, there cannot be a real surplus. So long as there is one unfed person in the world there cannot be a true surplus of wheat. So long as there is one man in the world who wants an auto and hasn't got it, there is no genuine surplus of automobiles.

The trouble is with our economics, and economics is the higher algebra of the ordinary law of supply and demand, just as high finance is merely the more complicated manifestations of the simple act of buying and selling.

The present depression would not have been possible in the days of the early pioneers when each family was an independent, self-supporting unit and supplied all its own wants in the way of food, clothing and shelter.

What Leads to Starvation

It may, however, be possible to obtain a clearer insight into just what is the matter with the world in general at the present time by going back to pioneer times and imagining the pioneers operating under our present system.

Suppose, for instance, that twenty men and their wives were placed in a single community so far removed from the other inhabitants of the earth that there was no possibility of communication.

Now assume that each of these men could do just one thing. One man could build houses, another could grow wheat, another could make clothes, and so on.

What would happen first? Obviously, the man who built houses would bargain with the man who could grow wheat and the fellow who could make clothes and agree to make them houses for some of the wheat and a suit of clothes. He would make similar bargains with other members of the colony who could make things he wanted.

For a while the house builder would be immensely busy building houses, but when he had finished twenty, then what would he do? The man who grew wheat, having a house, certainly would not give him wheat to build another one, and the other members of the colony would be in the same position.

The poor house builder would then be in a bad way and to avoid starving to death he would have to learn how to grow wheat himself. Then there would be two wheat growers and the competition would mean harder bargains and slim pickings for each.

The only difference between our imaginary colony and the world today is in the magnitude and complexity of the possibilities.

Nevertheless, we believe that science, without which neither our present population nor our present scale of living would be physically possible, will eventually come to the aid of the economists and financiers with some practical way to level out the disastrous ups and downs of our present scheme of existence.

How to Use the New Tubes in Your OLD SET

By ALFRED P. LANE

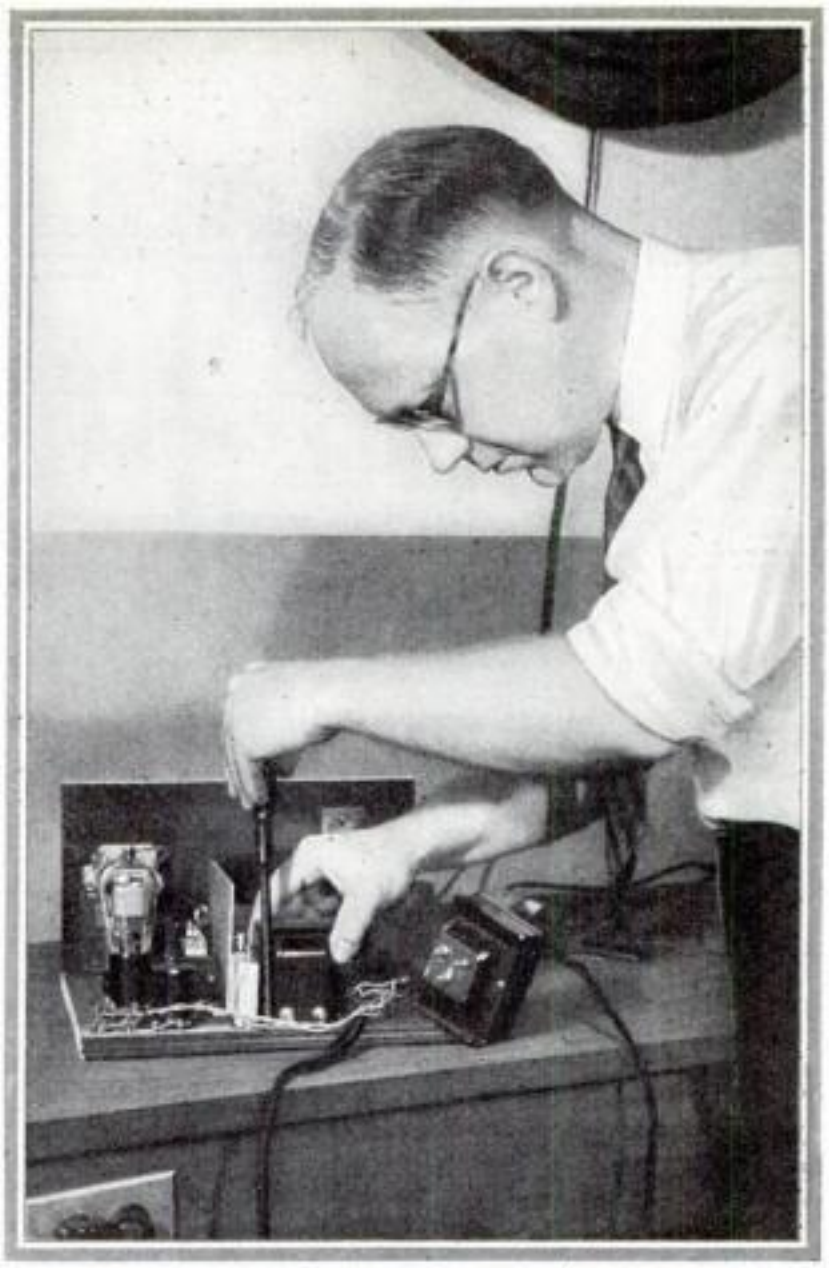


Fig. 1. Headphone Electric Set (Blueprint 130) being rewired for operation on direct current (diagram on page 72)

IS IT possible to use any of the new tubes in my old radio set? Will they give better results? What changes do I have to make in the wiring?

Thousands of radio enthusiasts have been asking such questions since the introduction of many new types of radio tubes. Such broad questions cannot be answered specifically, as there are a multiplicity of possible combinations. However, a statement of what can be done in certain cases should prove helpful.

When the new type 235 screen grid tube was announced in POPULAR SCIENCE MONTHLY and its features analyzed (P. S. M., June '31, p. 81) the electrical characteristics of the tube were such that it could be used in some sets to advantage without making internal changes. In others it gave poor results.

Now this type tube is being made in such a way that it will work in virtually any screen grid set in the radio frequency amplifier stages instead of the type 224 without making any changes at all. It is merely a case of replacing the 224 tubes as they give out with the new type 235 tubes.

This tube was designed to overcome tuning difficulties that resulted in what appeared to the user to be poor selectivity. This electrical effect scrambled stations on near-by waves so that one could not be heard without interference from the other. The difficulty appeared whenever you tried to choose between two stations of such strength that the volume control had to be turned down.

The type 235 screen grid tube, also called the variable mu tube, does not, when working with the volume control turned full on, give any greater selectivity or distance than the ordinary type 224. Its sole value lies in its ability to change its characteristics like a chameleon when the volume control is operated to reduce the sound from the loudspeaker. This change largely overcomes the tendency of the type 224 tube to cause interference under such conditions.

If you have a set using 224 tubes in the radio frequency amplifier stages, and you are troubled with cross-talk or interference, try using the type 235 variable mu tube in these stages. It is sure to give you as good results as you are now obtaining and it may effect a decided apparent improvement in tuning.

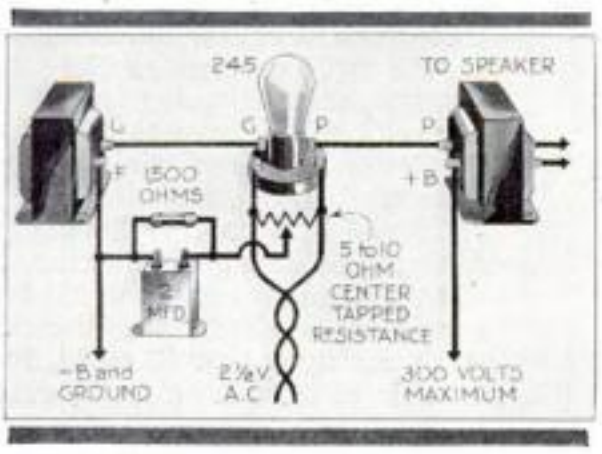


Fig. 2. The standard circuit for the 245 power tube as used in factory built or home constructed sets. It is easy to change to pentode

ANOTHER new tube that is much featured in the latest types of radio receivers is the power pentode. This tube, type 247 in the full size suitable for light socket sets, or type 238 in the lower powered size for battery operated and direct current light circuit sets, was described in a previous issue of this magazine (P. S. M., July '31, p. 76). The 247 power tube was evolved from the 245 power tube and is in some particulars quite similar to it.

The 245 tube has three electrodes, the plate, the grid and the filament. In the type 247 tube these three electrodes are retained and two more added, hence the name pentode meaning five electrodes. The two extra electrodes are screens. One functions after the manner of the screen in the type 224 and 235 tubes, the other forms a one-way electron trap that prevents undesired electron radiation from the plate.

As the type 247 power pentode is fitted with a base of the standard five prong type instead of the four prong base used on the 245, the first step in fitting your set for the pentode is the substitution of a new socket or two new five prong sockets if you have a push-pull circuit using two 245 tubes.

THE filament electrode of course requires two prongs so that the filament current can be circulated through it. In the standard five prong socket, the two terminals marked H take care of the filament. The control grid is connected to the socket terminal marked G and the plate goes to the P terminal of the socket.

The screen electrode that gives the tubes its great additional amplifying power is connected to the prong that contacts the K terminal of the socket. The remaining screen, the one way electron trap, is internally connected to the filament so no external connection need be provided.

Study the diagram of Fig. 2. It shows the conventional circuit for the type 245 tube as used in virtually all sets employing only one of these tubes. Then look over Fig. 3 which shows the circuit of Fig. 2 revised for use with the type 247 power pentode.

Note how the G and P connections remain unchanged, the wires supplying the filament current merely being moved over a bit and connected to the H terminals of the new five prong socket. In fact the only new connection is to the K terminal of the socket and this is wired to one end of a resistance the value of which is not at all critical. It may be anything from 1,000 to 5,000 ohms.

The new apparatus you will need consists of a new five prong socket, the resist-

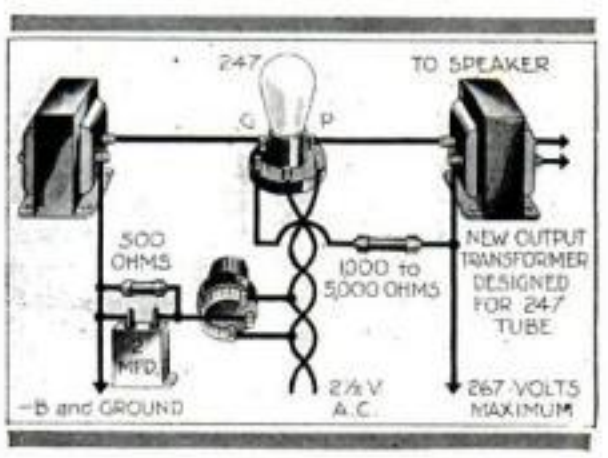


Fig. 3. How ordinary single 245 circuit looks after rewiring for power pentode, type 247. Note change in bias and added resistance

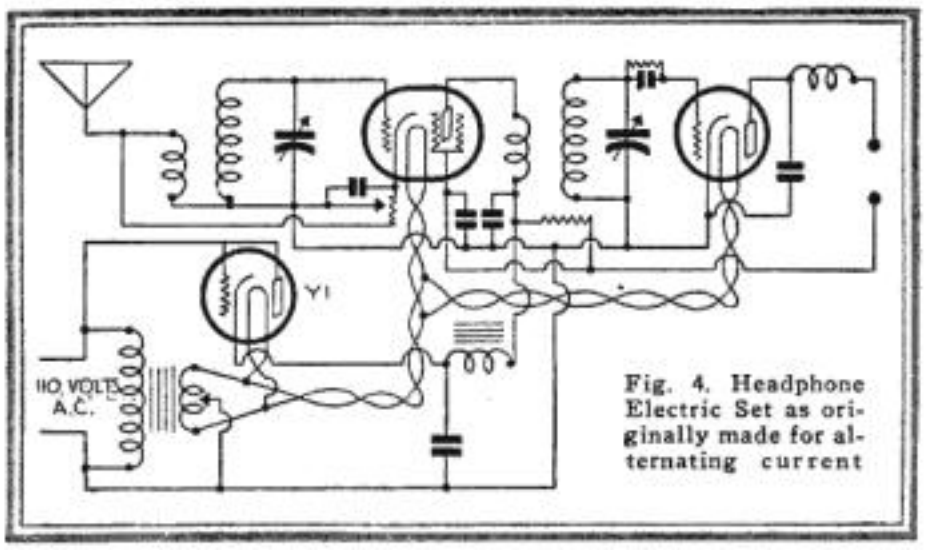


Fig. 4. Headphone Electric Set as originally made for alternating current

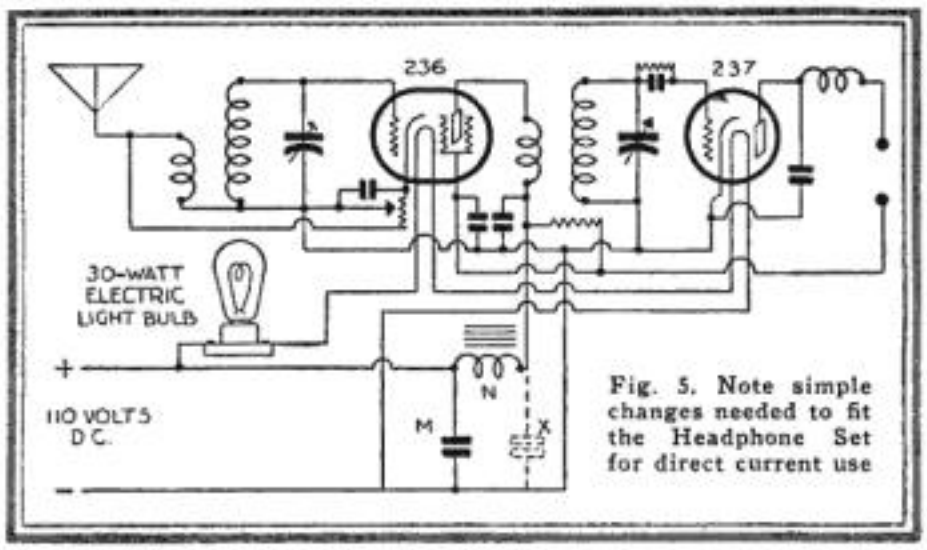


Fig. 5. Note simple changes needed to fit the Headphone Set for direct current use

ance already mentioned, a biasing resistance of 500 ohms to take the place of the 750 ohms unit now in your set, and a new output transformer designed to match the power pentode. This latter is not absolutely necessary but is desirable if you want the best results from the new tube.

If your set uses two type 245 tubes, the circuit is almost certain to correspond, in all essential details, with upper diagram of Fig. 6, and the method of conversion is shown in lower diagram. The change-over is no more complicated for push-pull than it is for the single tube circuit and, with the exception of an extra five prong socket and tube requires no more extra parts.

What are the advantages of either of these conversions? To begin with, you will get much greater audio amplification. This means that for any given setting of the volume control on any given station, the volume from the speaker will be markedly louder. There will also be a slight but probably noticeable increase in volume handling ability. In other words you can push the volume to a higher level before the distortion point is reached.

Another set of new tubes, the types 236, 237 and 238, already described in POPULAR SCIENCE MONTHLY (P. S. M., July '31, p. 76) present interesting possibilities.

These three tubes were brought out for use in automobile receivers and in direct electric light current jobs. The 236 operates in the radio circuit like the ordinary 224 A. C. screen grid tube, the 237 corresponds to the regular 227 tube and the 238 is power pentode of less power than the 247 already discussed.

TO show how these tubes can be used, we have taken the Popular Science Headphone Electric Set, which was described in detail last July (P. S. M., July '31, p. 83) and also in our regular blueprint No. 130, and altered it to use these tubes in two ways.

Fig. 4 shows the theoretical diagram of the Headphone Electric Set as originally designed to operate on 110-volt alternating current. Thousands of our readers have successfully built the set in this form. Full details, including picture wiring diagram, are given in Blueprint No. 130.

Fig. 5 shows the same circuit revised for use on 110-volt direct current. This arrangement will supply the demand, by many of our readers who live where direct current is in use, for the Headphone Set in D. C. form.

Compare the diagrams of Figs. 4 and 5 and you will see that the radio circuits are identical. The only changes are in the filament heating and B power supplies. The circuit in D. C. form is cheaper and simpler to build than in A. C. form. Note how an ordinary 30-watt electric light bulb in a cheap porcelain base socket takes the place of the filament heating transformer, and how socket Y1 and the 227 tube used as rectifier are eliminated.

IT IS a peculiar fact that it is sometimes harder to filter the "commutator ripple" or hum out of D. C. current than it is to get rid of the hum in rectified alternating current. If you build the Headphone Set for direct current and experience excessive hum, increase the capacity of condenser M and add another across the line at the other side of the filter choke N, as indicated in dotted lines at X. The small, 8 mfd. electrolytic condensers are suitable for use at both points.

You will observe that the filament heating wires in Fig. 5 are not twisted together. Twisting is unnecessary in direct current practice.

Another revision of the Headphone Electric Set is possible. This one is for battery operation in auto or boat. The same tubes are used as in the 110-volt direct current arrangement. As these tubes are designed to run on 6.3 volts applied to the heater terminals, they can be connected directly to a six-volt storage battery without the use of any rheostats. The simple circuit of the Headphone Set is not sufficiently sensitive to bring in stations on the usual short antenna that is concealed in the roof of an automobile. Fifty or sixty feet of wire hooked to the nearest tree while the car is parked will give good results.

OF COURSE the first step in altering the diagram of Fig. 5 for battery operation so that it can be used in an automobile or motorboat is to cross out the electric light bulb and the filter circuit which includes choke N and condensers M and possibly X.

Instead of connecting the heater elements of the two tubes in series as in Fig. 5, they should be connected in parallel, and connections should be brought out to a pair of binding posts or to some form of jack. The heating current supply should be taken directly from the battery wiring of the car, no rheostat or current control of any kind being necessary.

The 45-volt B batteries of any convenient size will be required to supply the necessary B current. The simplest wiring for them would be to connect the two batteries in series and hook them into the circuit in place of the filter circuit, which means connect them to the two terminals in Fig. 5 marked 110 volts D. C. plus and minus, which would give the right voltages to the set. Of course, choke N being removed, the circuit would have to be completed with a piece of wire to take its place.

Those of our readers who enjoy working out wiring problems cannot fail to notice how easy it would be to make up a Headphone Electric Set so arranged that it could, by the aid of simple change over switches, be made to operate on 110-volt alternating current, 110-volt direct current, or battery current as desired.

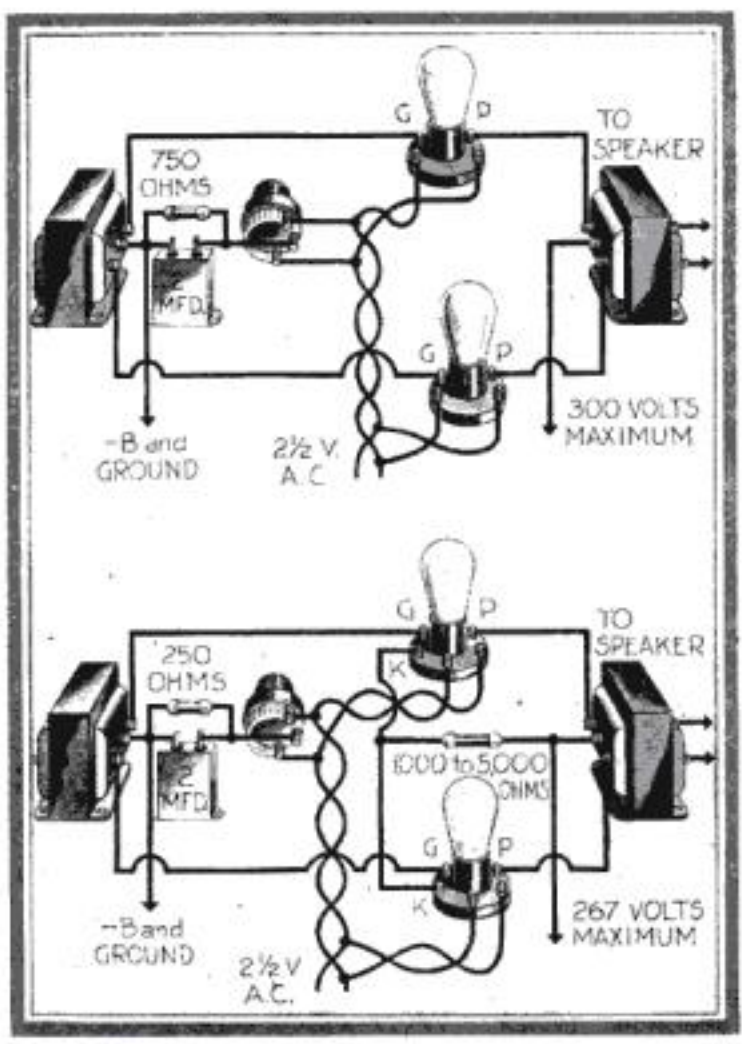


Fig. 6. At the top, standard 245 push pull; below, the circuit altered for the new pentode tube

Easy Way to Spot Trouble *in a Receiver*

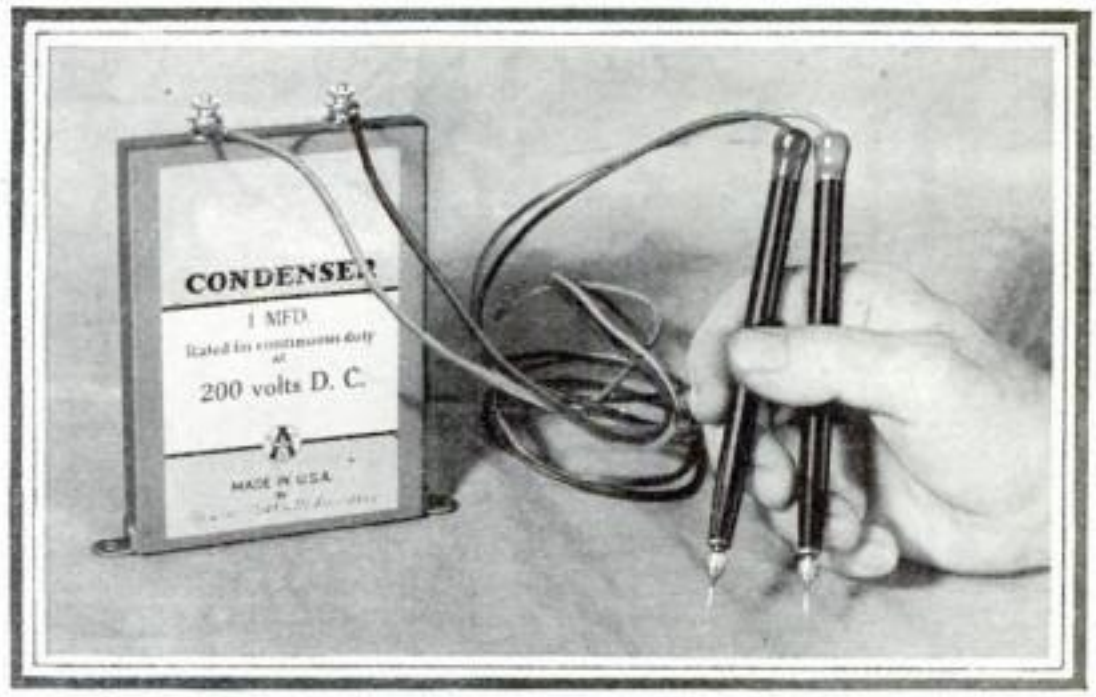


Fig. 1. Spare condenser connected to test points can be used to locate trouble in your radio receiving set if a fixed condenser has become short circuited

MOST experimenters know how to use test points connected to a voltmeter to find out if the voltages developed at various points in the circuit are correct. The same principle can be used in other ways. When the set is not working right you can connect the test points to the terminals of a variable resistance and use the combination to reveal several kinds of trouble.

Assume, for instance, that the resistance can be varied from approximately zero to, say, ten thousand ohms. Suppose that your voltage tests indicate that one of the resistance units in the set has burned out. You can set the variable resistance to about the value of the suspected unit and touch the test points to each end of it.

If your surmise is correct, the current which cannot flow through the burned out unit will pass, by way of the test prongs, through the variable resistance and the set will resume normal operation. If, on the other hand, providing another path for the current in this way produces no noticeable effect, you can be sure that the suspected unit in the set is in working order.

The same general method of substitution can be used in testing the various fixed condensers in the set. Condensers, however, are not quite so simple to test as resistors. A condenser may become either open circuited or short circuited. An open circuited condenser is one in which an internal connection has opened. This has the same effect as disconnecting the condenser from the circuit.

In the case of a short circuit, the insulation between the layers of metal foil that give the condenser its capacity may give out and the current then flows across from one layer of foil to the other. The effect on the circuit is the same as though you connected a piece of wire directly across the terminals of the condenser.

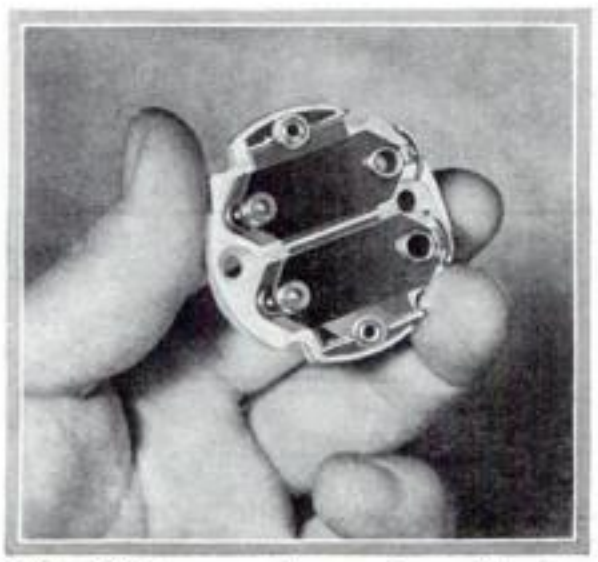


Fig. 2. This new condenser unit consists of a ceramic base and two adjustable condensers

Obviously, if you connect a spare condenser to the test prongs and touch the prongs to the terminals of an open circuited condenser, the spare condenser will function in place of the one in the set.

If the condenser is shorted, try disconnecting one terminal, then touch the disconnected wire with one prong and the terminal with the other. This puts the test condenser in series and the set will work. If the suspected condenser is in good order, both these tests will give virtually negative results.

In making such tests it is wise to use as a test condenser a unit having a high voltage rating. A small, low voltage condenser will short-circuit if you attempt to substitute it, even for a few seconds test, in place of one of the filter condensers.

A B C's of Radio

RADIO is rapidly developing a situation that parallels a phase of the auto industry—the replacement parts business.

You can now secure, at astonishingly low prices, a "replacement" condenser block, a power transformer and other parts for standard sets of past years' models. These "replacement" parts are of the same size and look exactly like the ones in your set, but in many cases the resemblance stops right there and some of these parts are next to worthless. The only safe way is to buy any needed parts for your set from the original manufacturer or, at least, be sure that the name of some reputable maker appears on the part.

Crystal Sets Popular

ALMOST the first practical radio receiver, long before the days of modern vacuum tubes, used a sensitive crystal to detect and rectify into audibility the radio signals. For the kind of reception demanded by present-day radio enthusiasts, the crystal set is, of course, inadequate.

However, under certain special conditions the crystal set serves a useful purpose and many thousands of them are sold every year. There are many millions of persons in this country who live within a mile or two of a broadcasting station. The strength of signal that can be received by these people on, say, a fifty foot outdoor antenna, is ample to operate the simplest type of crystal set.

Obviously, if you live in such a locality and want to receive only the local station and in addition you do not object to headphones, you can get results at trifling cost by means of a crystal set. Such sets can be bought today at prices ranging from sixty cents to a couple of dollars.

Remember that it was years before the tone quality obtainable from the loudspeaker of a vacuum tube set equaled that obtainable from the simplest crystal hookup. Today, of course, loudspeaker quality is better, especially on the low tones, than headphone reception because of the physical limitations on the size of the headphone diaphragm.

Superhet Coils Condenser

A novel condenser unit recently placed on the market, shown in Fig. 2, consists of a ceramic base on which are mounted two small capacity, adjustable condensers. The adjustment is made by means of a screw driver which operates a screw that slowly bends a curved plate down against a layer of mica insulation.

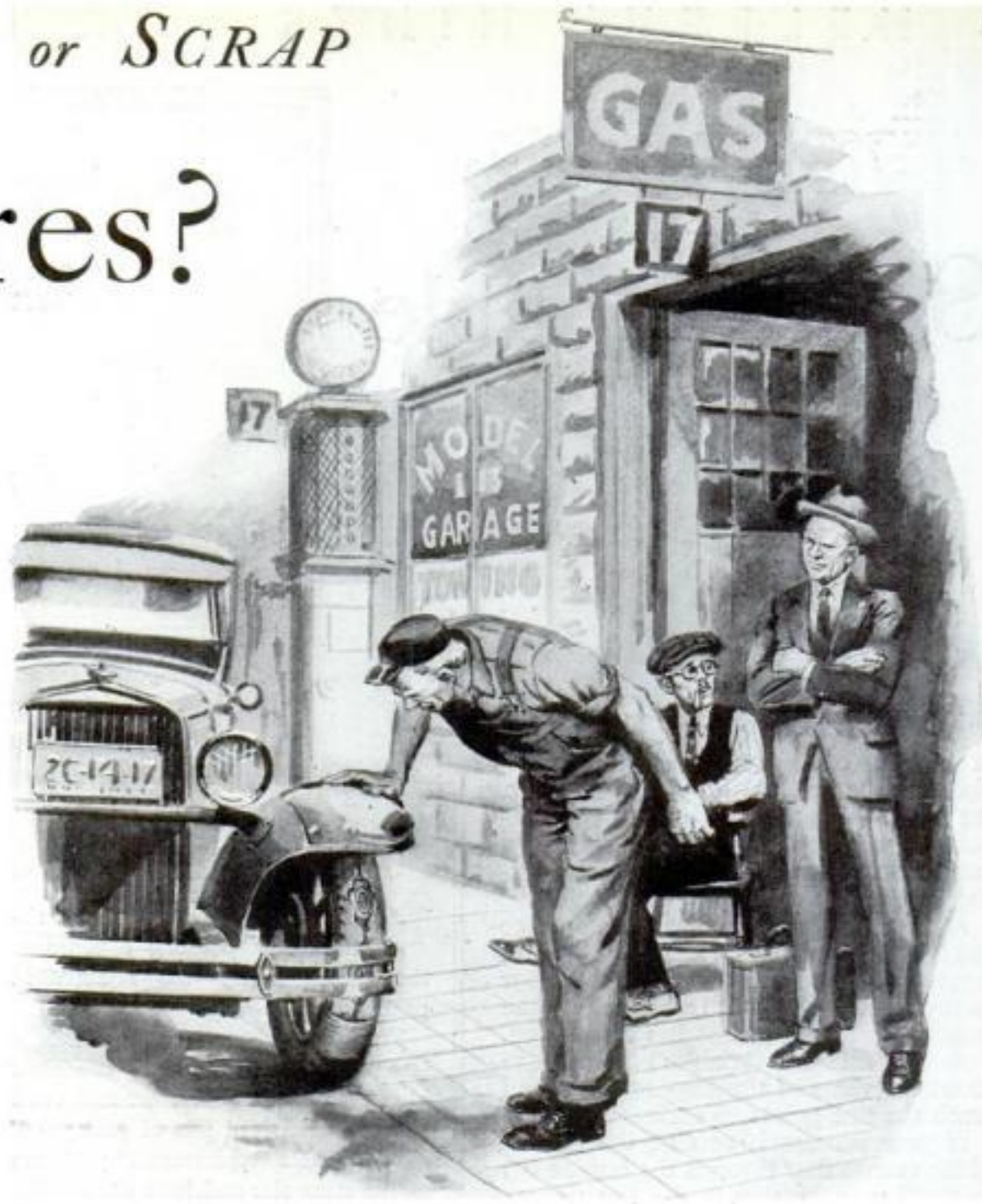
The size of the unit is such that it can be conveniently incorporated in the coil mounting. The maximum and minimum capacity of each unit is set so that the two condensers will serve to tune the two coils of a superheterodyne intermediate frequency transformer if the experimenter is careful with the winding.

Should I PATCH *or* SCRAP

Old Tires?

. . . That is the question car owners ask themselves and Gus this month tells why it's silly to tease miles out of a worn shoe

By MARTIN BUNN



"If it was my car," Gus said, "I'd scrap that old ring of rubber and put on a new shoe"

"NOW the question is," said Stoddard as he rubbed his thumb over the worn place in the tire, "shall I put on a blow-out patch or shall I wait till it blows out?"

Gus Wilson, half owner of the Model Garage, grinned and nudged his partner Joe Clark.

"If it was my car," he stated, "I'd throw that old ring of scrap rubber on the junk pile and put on a new shoe."

"There you go, trying to sell me a new tire," Stoddard grunted. "There's a lot of miles left in that one. Why throw it away because of one bad streak in the tread?"

"How long do you expect to keep that car, Mr. Stoddard?" Gus asked.

"What's that got to do with it?" Stoddard demanded.

"A lot," exclaimed Gus. "You've had that car now for a year and a half and you'll probably keep it that much longer. No matter how you baby that tire along, you'll have to replace it before you trade in the car. Isn't it sensible to put the new tire on now and have the pleasure and comfort of riding on it? Why let the bird who gets the car next have all the good out of the new tires you'll have to buy anyhow?"

"Sounds fine," Stoddard jeered, "but why buy something now that I won't need for maybe six months?"

"Because you'll save money on blow-out patches, inner tubes, and so on. Besides, isn't it worth something to drive a car without continually worrying about a tire blowing out?"

"Yeah, you'd have to count that, too, I guess," Stoddard grudgingly admitted. "Tires are a nuisance and an expense any way you look at them."

"Not by comparison with what they used to be," Gus commented. "You fellows today don't realize what good tires you're getting. You kick if you don't get better than fifteen thousand miles out a shoe. I can remember when two thousand was something to brag about, and only one puncture on a fifty-mile trip was a lucky break. When a car owner went on a two or three hundred mile trip he had to carry as many as four spare tires! Those were the days when tire trouble meant something.

"And it was *tires* we carried then," Gus continued. "Not spares all mounted on rims or spare wheels. When we got a puncture or a blow-out, it took a mighty husky man on the end of a twelve or eighteen inch tire iron to take the flat shoe off the wheel and put the spare on.

"I can remember one trip when I blew out three tires in fifty miles and came home with one shoe stuffed with grass and old newspapers.

"You fellows kick about expense. How would you like to fork over fifty to seventy-five dollars for a shoe about half as big as yours, knowing that it wouldn't last over three thousand miles?"

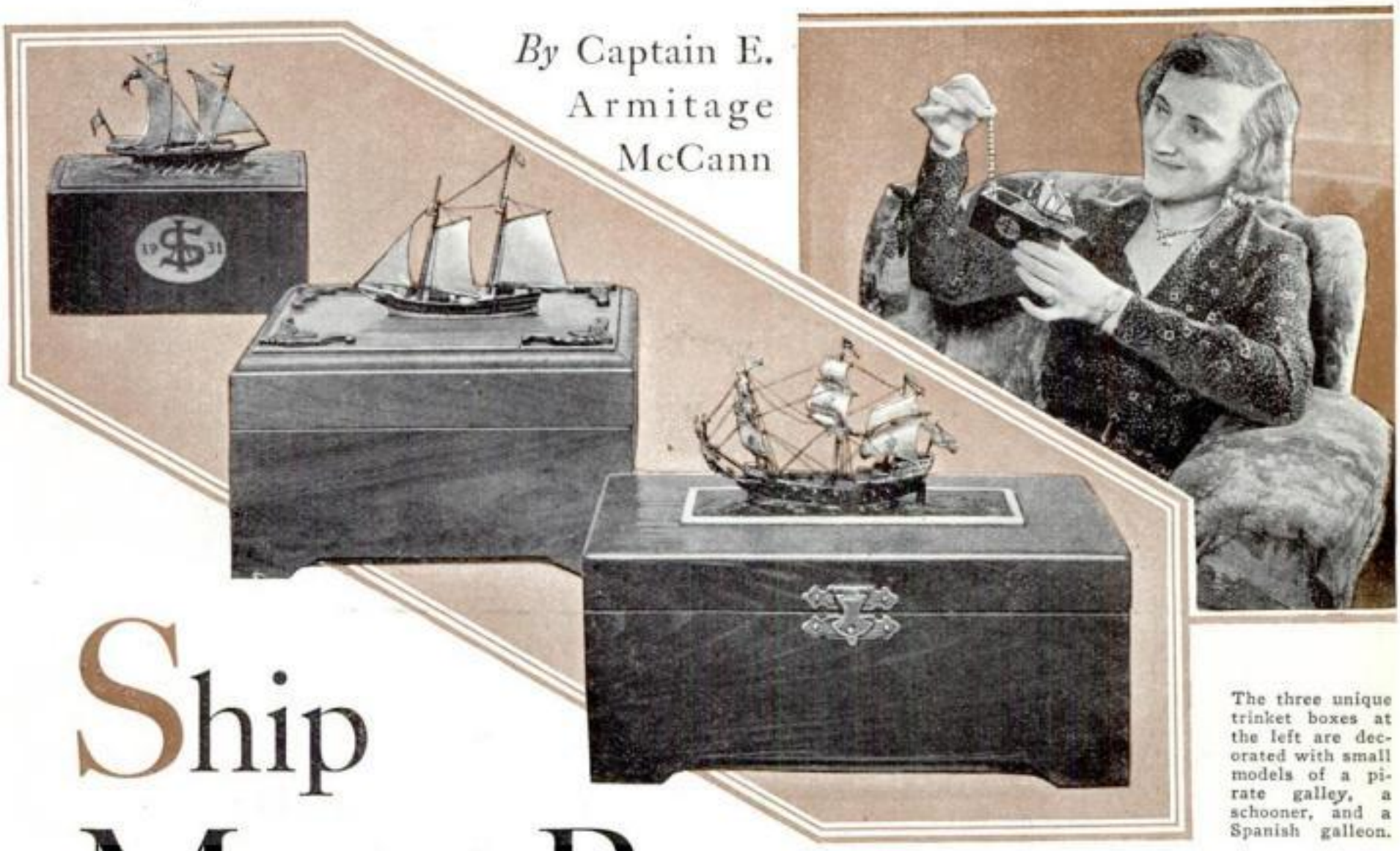
Stoddard laughed. "If it was like that now I'd never be able to afford a car. As I understand it, you don't think it pays to fix tires at all. Is that it?"

"It all depends," said Gus. "Of course it pays to have punctures fixed and it sometimes pays to have blow-outs fixed if the trouble is a bad cut when the tire's nearly new. But when a blow-out comes from wear and old age—buy yourself a new shoe. Some people don't mind buying tires for cheap, light cars, but think that tires for more expensive cars should be fixed. That's the bunk. Doesn't the heavy car need better support? Isn't it more likely to be damaged by a blow-out?"

"The big tires cost more," Stoddard objected. "Why not try to make them wear longer?"

"Tires for a medium size car cost far less now than *(Continued on page 127)*

GUS *says* . . . **There are lots of auto drivers on the road today who don't believe in signs or else they're about half blind. Just stand near some corner where there's a "full stop" sign and watch the dumb ones and the blind ones go sailing by as though the sign said "full speed." Shooting by full stop signs may give you a thrill, but remember that if you get into a smash, your thrill may cost you plenty!**



The three unique trinket boxes at the left are decorated with small models of a pirate galley, a schooner, and a Spanish galleon.

Ship Model Boxes

A New Idea for Making Beautiful Christmas Gifts at Trifling Cost

By Captain E. Armitage McCann

IF YOUR friends are like my friends, when Christmas comes around they will all be expecting you to give them ship models. And it just can't be done—ship models take too long to make.

Here, however, is an idea by which you can, without too much trouble, satisfy the longing of some of your friends and make presents that will be highly appreciated because they are individual, unpurchasable, and, most important of all, very good looking.

The idea is to make miniature models of any of the ships of which full data can be found in the POPULAR SCIENCE MONTHLY 'ship model blueprints listed on page 108. When finished, the models are mounted on the lids of small ornamental boxes which may be used for trinkets, cigarettes, stamps, or what you please. They also may be applied to various other small novelties.

In making a model only from 2 to 4 in. long, it is essential first to consider the technique to be employed. Your model at some time may be dropped on the floor or carelessly handled, and it should not then represent a wreck. Therefore, the rigging is best made of metal. In the illustrations, the pirate galley and the Spanish galleon (Blueprints Nos. 44-45 and 46-47) have wooden hulls and are all metal aloft. The schooner—it was built for a careful person—is made entirely of wood. I propose describing how I made the galleon. The technique for any other model would be the same.

The first thing to do is to take your blueprints and from them make a drawing to the size of the miniature model. While doing this, decide what details are essential, and what can be left off. Take the hull, for example. This I made from one piece of hardwood, beginning about 3/16 in. below the water line. I sawed down to the different bulwark levels, cut away the waste, and then chiseled out to the deck levels, leaving the bulwarks standing. I omitted the handrails and galleries.

The beak is a piece of thin brass set in a knife-cut in the stem. The headboards are represented by a wire that passes through a hole in the beak and into holes in the hull. The rudder is of brass.

The deck guns are pieces of brass wire bent to a right angle, one end of each being set in a hole in the deck and the other end protruding. The inner parts are painted black and the outer left bright. The lower guns are merely straight pieces of wire set in holes.

I then made a scale drawing of the

masts and yards, but left them a little less lofty, with masts and flagpoles in one piece. For ease of construction, I changed the mizzen to two lateens.

The masts are of No. 18 tempered brass wire and the yards No. 20 (brass rod, however, is better). These are tapered at the ends with a file. The bowsprit and sprit-topmast are one piece, bent to the correct angle. As the masts are conspicuous, I set celluloid rings on them for the tops. Then I soldered the yards across the masts. To facilitate this and the following operations, I laid the masts in a groove cut in a piece of wood.

The sails I made from sheet brass, about the thickness of two sheets of this magazine paper, but, of course, considerably stiffer. I cut them from the mast-and-yard pattern, but made the sails about a fifth deeper to allow for the belly. All the sails for one mast are in one piece. I then laid the mast back in the grooved piece of wood and soldered the sails along their top edges to the yards.

The flag at the lateen is part of the sail; the other flags are cut with a droop and are soldered to their masts.

For the rigging some No. 30 annealed brass wire is best, but strands from electric light wire will do. The neatest method is to drill holes at the mastheads and reeve the wires through, but this is a lot of trouble. I used a double wire for the lower stays and a single one for the upper, and passed all around the mast; then I passed the bight of another wire through this bight for the backstays, one to come down each side, with two or more similar bights for the lower shrouds. Next I twisted the stay wire close up, and fixed the whole in position with solder.

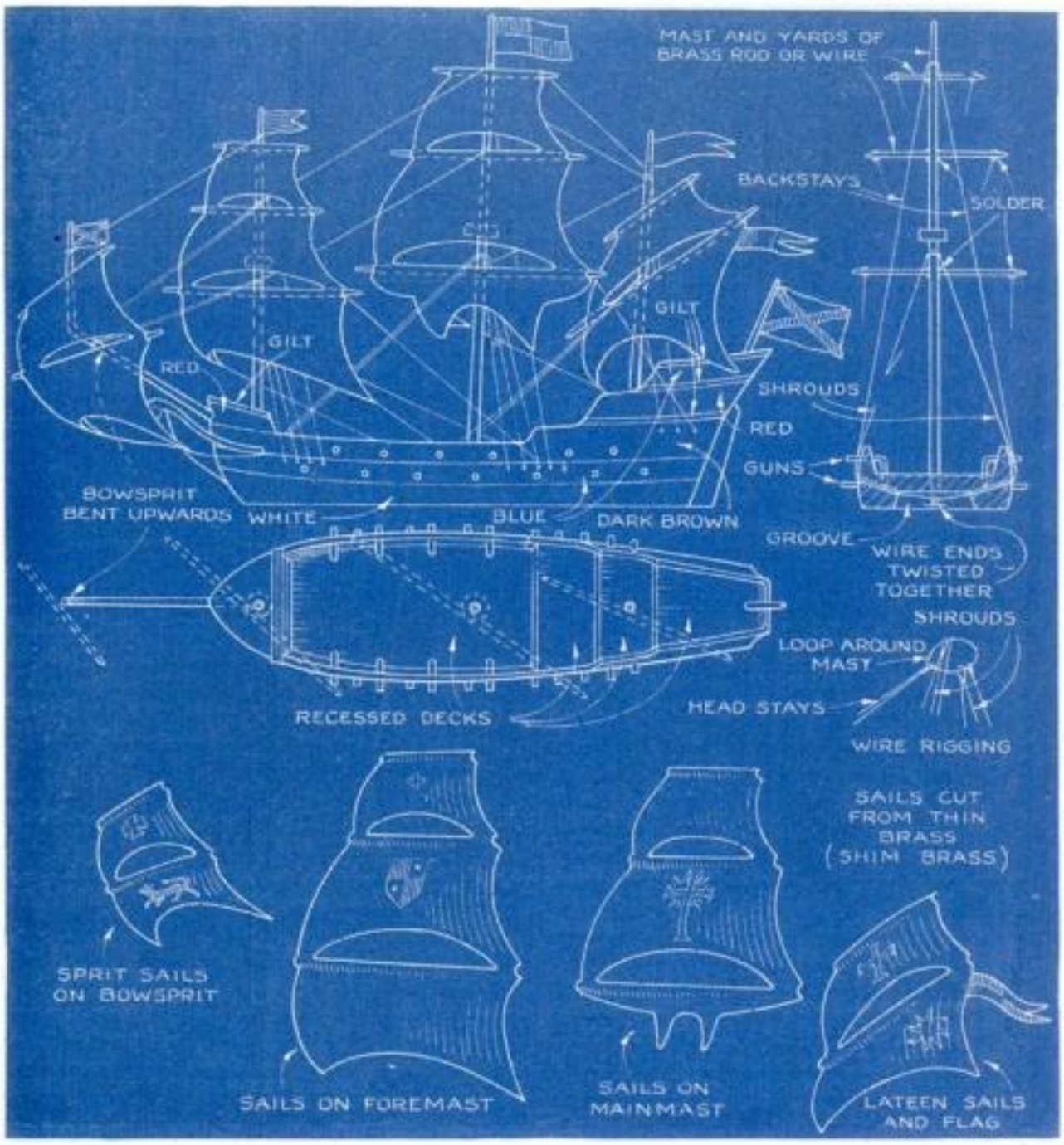
The masts are now ready to ship. Place them in holes in the hull at the proper angle and height. Fasten the stays, either to the other masts or through holes in the deck, as required. For the shrouds and backstays, I scooped grooves in the bottom of the hull and drilled holes from the ship's sides to these, and passed the ends through and twisted them up in the grooves.

The braces and sheets, which are pieces of similar wire soldered to the yardarms and clews of the sails, are fastened off the same way, excepting the braces which come to the mastheads; these go round the masthead and back to the yardarm.

Add any other details to suit your fancy, such as small boats, fife rails, sailors, and the like.

The painting is most important. I fastened my models temporarily to a piece of board, with a screw from underneath, and gave the whole a priming coat of thin white enamel, excepting the deck, which was varnished. For the final painting I suggest artists' oil colors

Captain McCann painting the realistic plastic composition sea surrounding the tiny galleon model. In painting the model itself, artists' oil colors were applied with small sable brushes over a thin undercoating of white enamel.



applied with two sable brushes, one very small. Paint in the actual colors if the model is a real ship (such as the *Sovereign of the Seas, Constitution,* or *Bluenose*) or to your own taste if it is a purely decorative model. If desired, antique the model with raw sienna and Vandyke brown, and use some toned-down gold here and there. When the model is finished and dry, scrape the paint off the guns and give the whole a thin coat of varnish. To get the most brilliant effect, apply the paint lighter than the desired finished effect, then paint over a second time with thin, transparent colors.

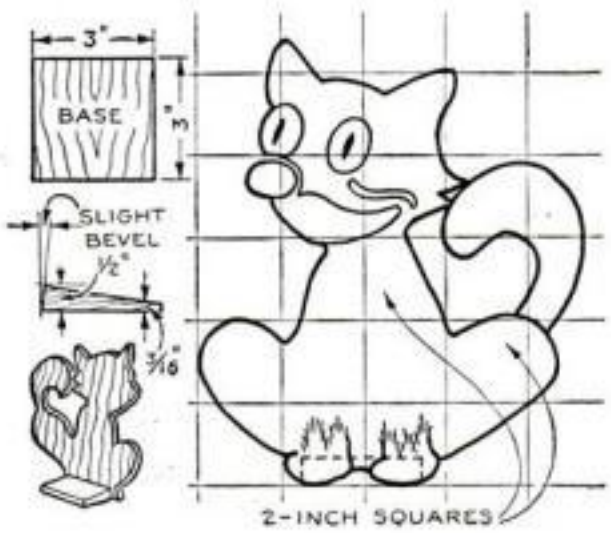
The ships will look better if the bottoms are sandpapered on a slant so that they will lie over slightly. A suitable way to fasten them to the box or other object is to set them in a sea of commercial plastic composition or artificial wood, but also drive a wood screw up into them. The plastic sea may cover the whole surface or be contained within a molding. My schooner model was set on the box without any sea.

I bought unpainted boxes to mount my models on, but that need not prevent you from making your own. Boxes for cigarettes, stamps, or the like will not be lined, but might have a ship picture glued or painted in the lid. For a trinket box, make a lining of silk, satin, or velvet.

AMUSING DOORSTOP CUT FROM OLD BOX

An amusing yet practical doorstop may be made as shown by any handy workman in about an hour's time. The wood in a canned goods box will provide the necessary lumber. One of the sidepieces will serve for making the body, while the thicker wood from one of the ends will supply the base. If the doors happen to be hung rather low and barely clear the floor, it may be necessary to taper the back edge of the base of the stop to a little less than 3/16 in. After the body and base have been cut out and smoothed up, the body is attached to the base with finishing nails, and the whole is given a coat of black enamel or lacquer. The paint on the base should be thin so that it will not be likely to be scraped off by the door, but the body should be given coats enough to insure a brilliant gloss. When the black

This black guardian of the door is a humorous conception but efficient, nevertheless.



is dry, the green eyes with their bright yellow slits may be painted on, and these followed by the mouth, paws, nose outline, and cheek outline, all in white. Where the white paws join the legs, very little paint is used on the brush, so that the white is "fuzzed out." This will give the appearance of white and black fur blended together. If lacquer is used, it is wise to apply a thin coat of shellac over the black before applying the eyes, paws, and other markings. This will prevent the black from "bleeding" through and causing the colors to show undesirable smudges of black.—Norman V. Davidson.

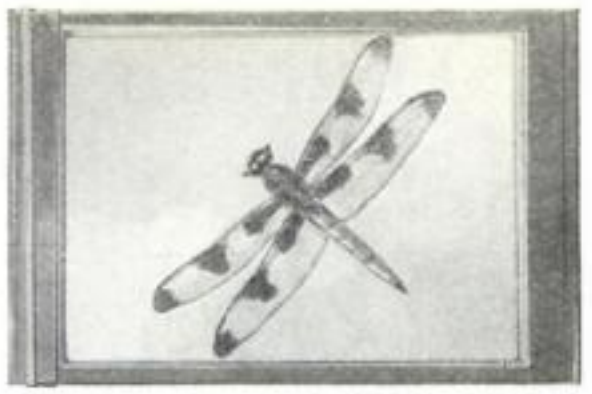
SHEET LEAD PLATE ORNAMENTS DOORBELL PUSH BUTTON

If your front door has wrought iron hardware, which is now so popular, you can make the doorbell push button match perfectly by ornamenting it with a plate like that illustrated, or of any desired shape. The push button itself is of the common type designed to be set flush into a 5/8-in. hole and with a so-called "pearl" center. It usually costs about fifteen cents. The plate is made of 1/8 in. thick sheet lead 1 5/8 in. wide and 3 in. long. It is hammered on the face side with a ball pein hammer, and the edge is beaded down with the hammer. A 5/8-in. hole is drilled in the center of the plate so the button can be inserted, and a small hole is drilled at each end for roundhead blued wood screws. The piece has the appearance of wrought iron with the advantage that it will not rust.—Dick Hutchinson.

This push-button escutcheon resembles wrought iron.

STAND FOR CAPPING BABY'S BOTTLES

Busy mothers who have to fill and cap a day's supply of bottles with a special baby's feeding formula will appreciate an easily constructed bottle holder. It will save many bottles of spilt milk. The holder is made of thin wood—1/4 in. thick will be satisfactory. The base is approximately 6 in. wide and 7 in. long, the sidepieces 3 1/2 in. wide and 3 1/4 in. high, and the top 3 1/2 by 7 in. The hole in the top should be just large enough for the bottle to slip through easily. If wide-mouthed pyrex type bottles are used, the hole should be hexagonal. The bottle rests on a 2 1/4-in. glass cup or shoe of the type used under furniture legs.—Dana S. Greenlaw.

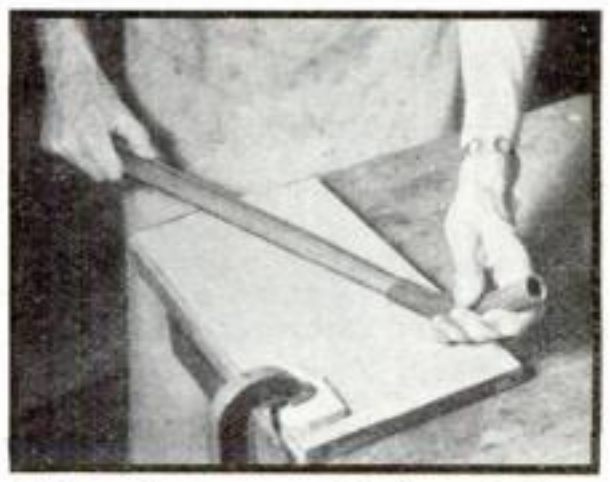


NEAT REVERSIBLE CASES FOR FLAT SPECIMENS

Anyone interested in collecting insects or small, flat, fragile specimens of any kind will appreciate the advantage of having a supply of frames or cases like that illustrated. It has glass on both sides and therefore allows the specimen to be examined top and bottom without danger of accidental damage. In addition, it is neat, light, and inexpensive. The principal part of the case is a discarded film-pack frame, which can be obtained for the asking from any photographer who uses film packs. A piece of thin, clear glass—a clean photographic plate is excellent—is dropped into the metal frame and four strips of cigar-box wood are cut to form an inner frame upon which the second sheet of glass may rest. This second piece, which really forms the back or bottom of the case, slides into place and is held at one end by the turned-over lip on the film-pack frame. For the sake of neatness and to hide the wooden strips, the edges of this piece of glass may be bound with black passe partout tape. A rubber band around one end of the case will keep the removable glass from falling away from the cigar-box wood frame.—B. G. S.

HOSE ACTS AS BUFFER ON END OF RASP

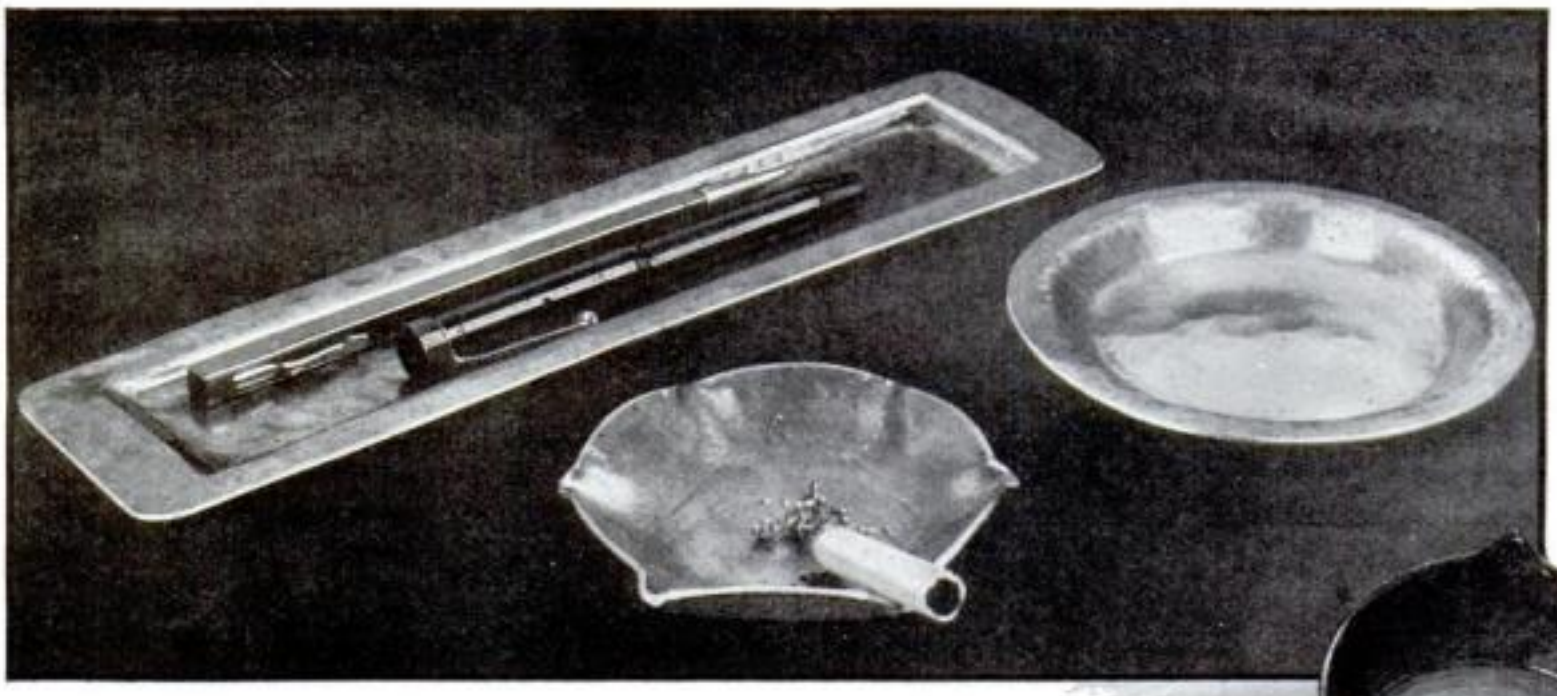
When veneering is glued to the edges or ends of a table top or other furniture part, the usual practice in removing the veneer which projects beyond the surfaces is to employ a half-round wood rasp with the end wrapped in a cloth so that surface scratches will not be made. A better method is to slip a 6 in. long piece of rubber hose over the rasp tip. A piece that is permanently curved from previous bending is more convenient than a straight length. In addition to providing a durable cushion that keeps the rasp from cutting into the surface of the board, the hose section acts as a comfortable handle, which will serve to protect the fingers of the left hand.—Ervin Walters.



Using a large rasp to trim the projecting veneer from the edges of a small table top.

You can make *Beautiful Pewter*

By
EDWARD
THATCHER



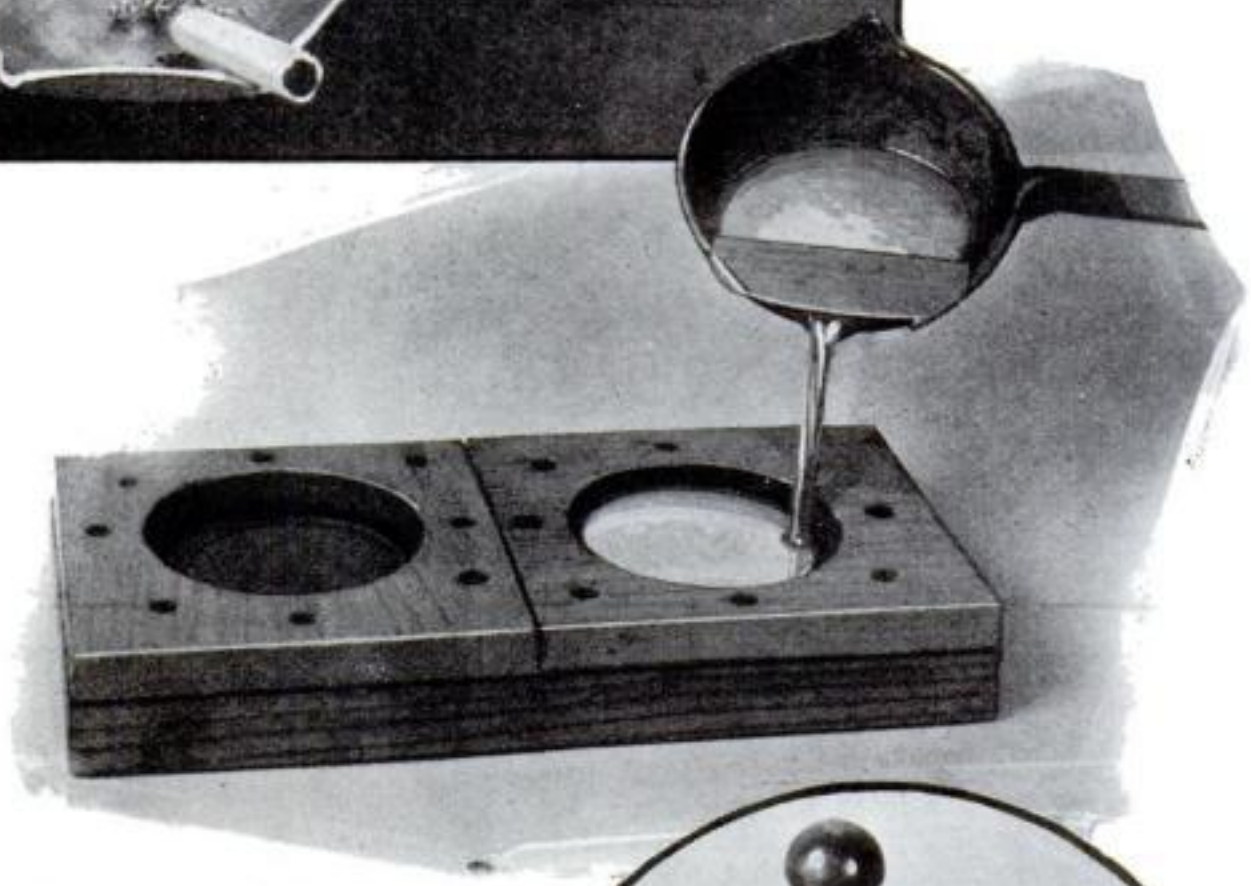
Hammered pewter ware is prized for its characteristic silky looking sheen and because it happens to be fashionable at this time. At the left are three trays of pewter.

POPULAR as pewter work has become, it is usually difficult for the home craftsman to obtain the metal in sheet form. However, he can make his own quite easily because the common soft solder known as "half and half"—that is, 50 percent tin and 50 percent lead—closely approaches in quality the genuine old English black pewter, which is 60 percent tin and 40 percent lead. Soft solder made of pure tin and lead may be hammered indefinitely without cracking; and rightly handled, this metal may be shaped up into very attractive, durable, and useful bowls and trays of small diameter, such as ash trays or bottle coasters.

A bar of soft solder as commonly sold weighs about 1½ lb. and is more than enough to make three ash trays 4½ in. in diameter and ½ in. deep. The ingot molds are made of two pieces of dry wood with a layer of asbestos paper between, as shown in the drawings. The upper part may have the opening sawed or turned in it. Two or more of these open mold forms may be fastened to a single bottom piece. Paint the whole interior of the mold with a small quantity of yellow ochre powder (obtained at the paint store) mixed to a creamy consistency with water. Form a sort of fillet with the wet mixture between the lower edge of the sides of the mold and the asbestos paper to prevent the molten solder from running under the edge. Set the mold on a warm radiator or in a moderately warm oven to become thoroughly dry and warm before being used.

A clean iron ladle at least 4 in. in diameter, with a pouring lip, should be obtained from the hardware store. Cut the bar of solder into about 3-in. lengths with a cold chisel and place three or four in the ladle. Set it on a good hot fire in a forge, or place it over a bright coal or wood fire in a stove, or over a gasoline furnace.

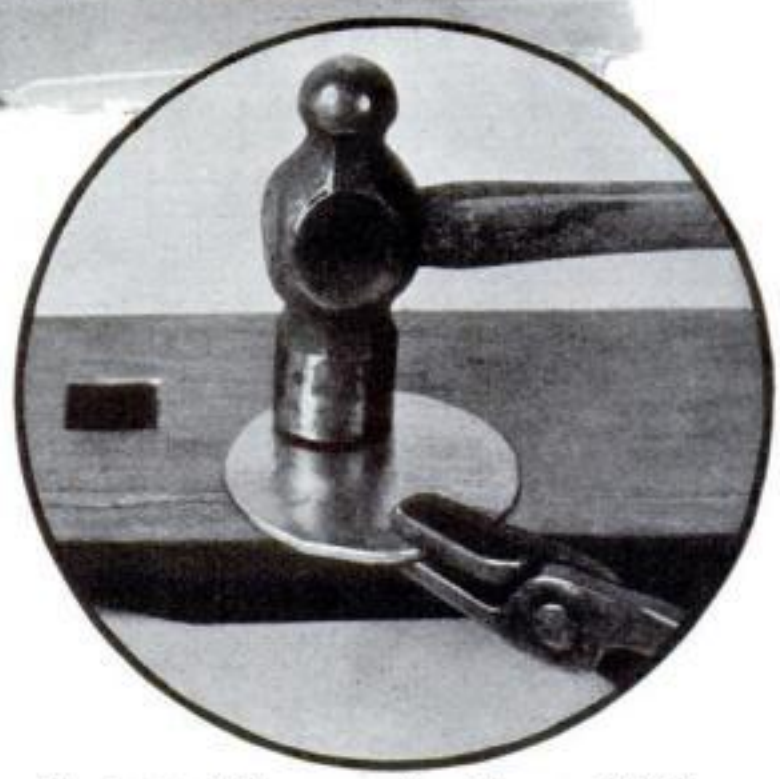
See that the ingot molds are freshly warmed and dry and are set level in a convenient place for pouring. Continue melting the solder until it is fluid and hot enough to ignite a sliver of dry pine stick when pushed into it. It is most important to have the metal at just the right temperature; if it is poured too hot or too cold, the metal is apt to crack later on when being hammered.



Pouring molten "half-and-half" solder into a double ingot mold made of wood and asbestos paper and painted with yellow ochre.

Before pouring the metal, stir it quickly; then use the curved end of a light, flat iron bar to skim the surface skin away from the pouring lip. When ready to pour, move the flat part of this bar over the lip of the ladle to form a sort of dam to prevent any dirt or dross from entering the mold. One of the photographs shows a ladle especially equipped with a dam on the lip to hold back the dross. Fill the mold quickly, pouring with a circular motion; that is, run the stream of hot metal around the mold in such a way that it fills quickly and evenly until the metal is ¼ in. deep. A pencil mark previously made on the side of each mold will serve as a guide.

Allow the filled molds to stand without moving them for at least ten minutes, until the metal is thoroughly frozen or set. The ingots then should fall out when the molds are turned over, and the metal is ready to be hammered.



The ingot is held on an anvil and hammered lightly on each side until it has been beaten into a 4½-in. disk.

See that the face of the machinist's or planishing hammer which is to be used is as smooth and highly polished as possible. Remove any scratches or indentations with a smooth file and coarse and

Novelties from COMMON SOLDER

fine emery cloth. The face of the hammer should be slightly rounded or domed, and the edges of the face also should be rounded over. These requirements apply equally to the anvil or stake faces.

The ingot may be held with the blacksmith tongs at first when it is rested on the anvil face to be hammered; after it gets larger, it may be held with the fingers. Start hammering rather lightly on the outside edge of the ingot, working gradually toward the center. Then turn the ingot over and hammer the other side in the same way. Turn it over once more and hammer as before. After the surfaces have been hammered over once or twice, the force of the hammer blows may be increased, but avoid making any deep, irregular markings. Continue the hammering until the disk is about 4½ in. in diameter and about 3/64 in. thick, or slightly less than 1/16 in. Do not make your pewter too thin, or it will not stand up well in use. No annealing is necessary as pewter does not harden up under the hammer.

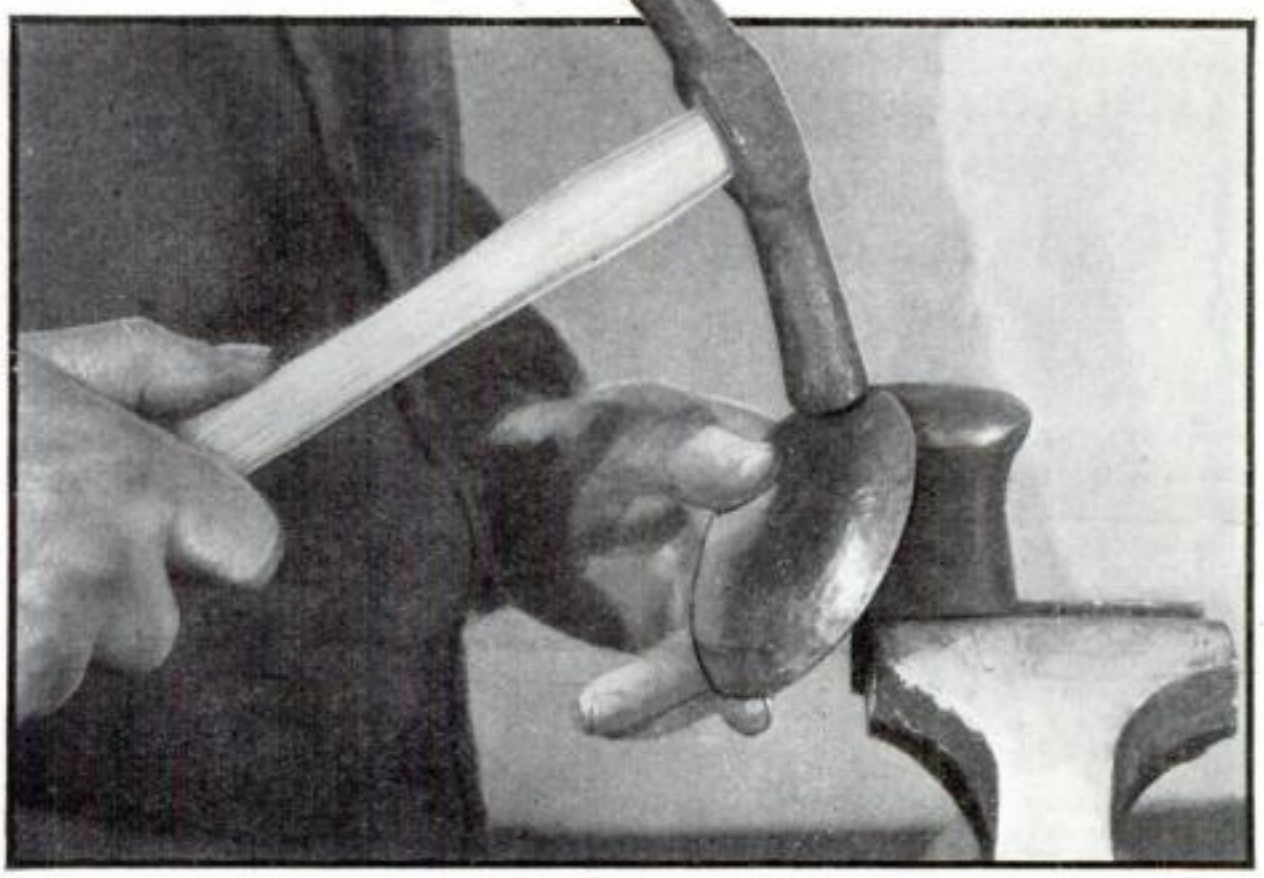
Next scribe a circle on the disk after placing a small piece of cardboard in the center on which to rest one leg of the dividers. Carefully trim away the excess metal and save the scrap for the next melt.

Generally speaking, it is better to form a bowl shape or tray by compressing the metal with light hammer blows, the metal being placed on a stake or anvil form, rather than by stretching the pewter down into a hollow wooden form, although the latter may be done with light hammer blows that stretch the metal a very little at a time.

The six-sided ash tray shown in the upper photograph on page 78 was worked into shape very slowly with a wooden hammer between two six-sided wooden blocks as described in a previous article in this series (P. S. M., July '28, p. 80).

The round tray is made as follows: After trimming the ingot to a circular form, a second circle 3 in. in diameter is scribed to serve as the base line. The work is then placed on a stake of knoblike form, with a slightly rounded top and well-rounded edges; and an embossing hammer with slightly domed ends is used to drive up the "sides," if they may be called that. Very light hammer strokes are used as you work around and around (see P. S. M., Sept. '29, p. 92). The hammering is continued until the form will just fit into a turned wooden form made as shown in the drawings.

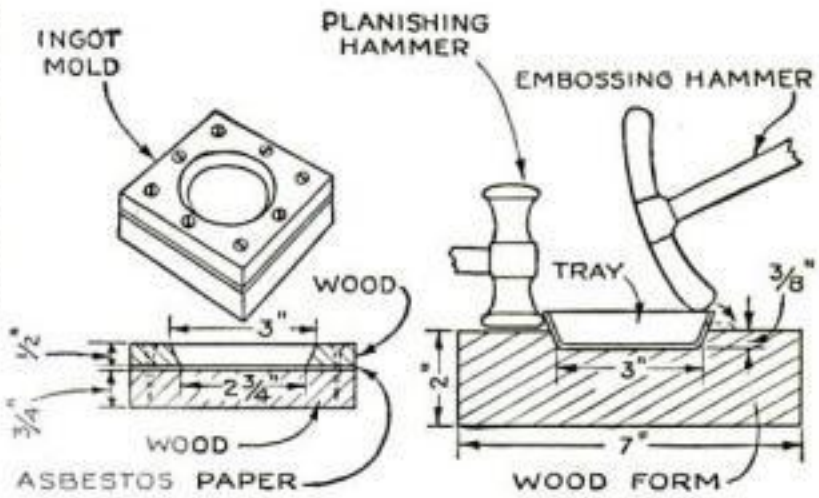
While the tray is still in the form, the rim is turned down and smoothed carefully with a planishing hammer.



Before the round tray is placed in the wooden form, its rim is turned up on a knoblike stake.

When hammering pewter in this way, it is better to use a wooden hammer when you come to the outer edge to avoid thinning the metal too much. A regular planishing hammer may be used after you have finished with the embossing hammer.

The rim is flared out or turned down while the tray is still in the wooden form. Use either a wooden hammer or an embossing hammer to drive the metal very lightly out and down, as shown in the drawings. Then use a smooth-faced planishing hammer as shown in one of the photographs to smooth up the rim.



How to construct a mold for casting pewter ingots, and a form for making a round tray.

The pen tray is made by hammering out half a bar of soft solder on the anvil to obtain a sheet of metal 1/16 in. thick, 2¾ in. wide, and 10 in. long. Care should be taken not to allow any metal to lap or fold over under the hammer to form "cold shuts," which develop into cracks.

The forming of the pen tray is a very simple operation. False vise jaws are made of cardboard to protect the pewter, and the rim of the tray is held between the jaws and moved along as necessary while a blunt wooden tool is used to drive down the metal, forming the base or tray proper. This method has been described before (P. S. M., Apr. '29, p. 81).

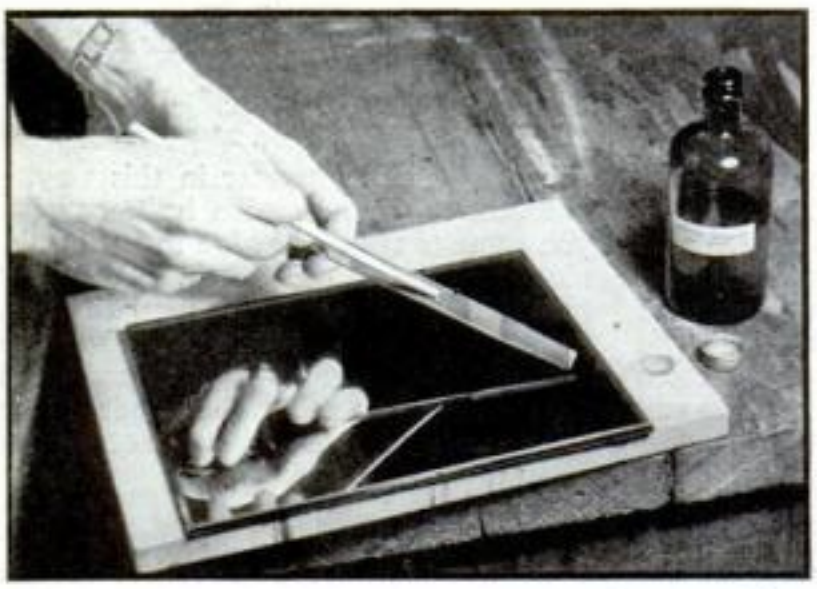
An old rough-cut file may be used to smooth and true up the edges of the work. Do not use your good files for this. Emery cloth will remove the file marks, and any accidental marks may be taken out by using a piece of jeweler's Scotch stone and water, after which the metal may be polished as usual.

A simple way to polish pewter is to use fine steel wool. The time-honored method, however, is to dip a large cork first in sweet oil (or auto lubricating oil) and then in powdered pumice stone, and rub briskly with the cork to get the silky looking polish.

HANDLING MINUTE PARTS

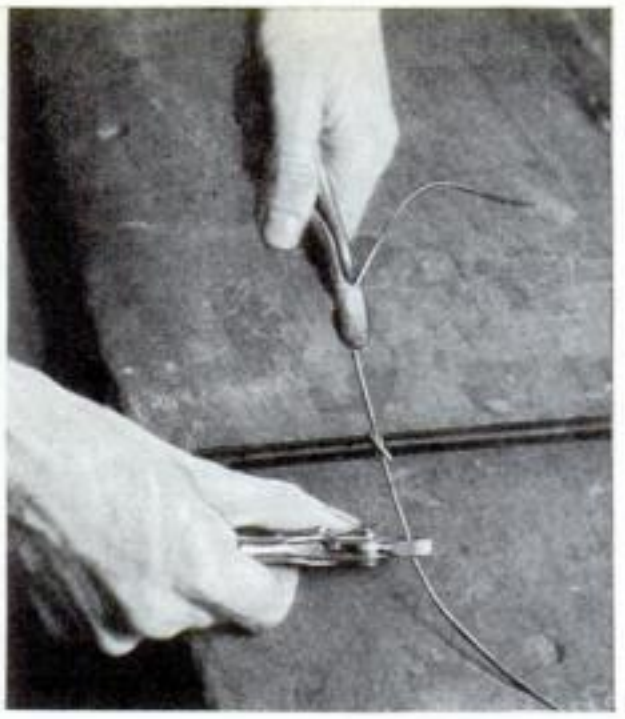
SHIP model makers have long known the value of tweezers in working with minute parts and intricate rigging. Those who build airplane models also will find it helpful to have a pair of dissecting or nail tweezers on hand for placing small pieces in difficult places.—BARRY TELFAIR.

COMPOUND AIDS IN MACHINING GLASS

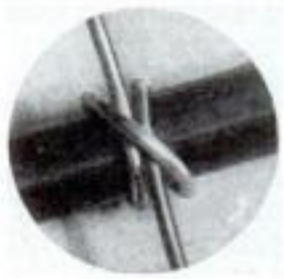


Camphor dissolved in turpentine is an excellent cutting compound for drilling, turning, and filing glass objects

Many uses will be found around the shop for a cutting compound made by adding about 1 oz. of camphor to 6 oz. of turpentine. This mixture will lubricate drills and cutting tools used on very hard metals, but its greatest service is in the working of glass. With a steel twist drill properly tempered in salt water or suitably hardened by some other means, holes can be drilled in glass almost as easily as in cast steel if the turpentine-camphor compound is used. The drill works best, as a rule, when operated fast and fed lightly. After a hole has been drilled through glass, it can be enlarged with a round file wet with the solution. A mill file of about the 12-in. size, when lubricated with the compound, will make the filing of glass an operation similar to filing brass. For example, a plate glass mirror can be beveled in a few minutes by first using a lubricated file and then finishing with a fine emery stone. Even the turning of glass objects in a lathe is not a difficult process if properly tempered tools and the turpentine-camphor compound are employed. Files held in the tool rest make suitable tools. If, in making up the compound, it is not convenient to weigh the ingredients, simply use sufficient turpentine to cover the camphor; then more may be added from time to time as the mixture is used until the camphor disappears entirely.—W. E. B.



Above: Using two pairs of pliers to tie a wire to a rod with a regular clove hitch. *At right:* Larger view showing just how knot is tied

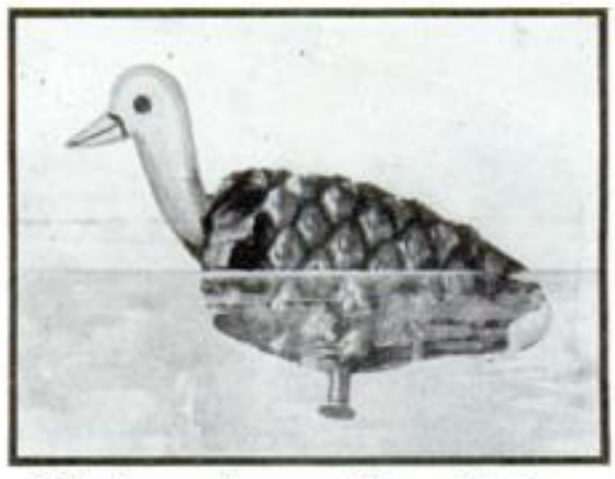


CLOVE HITCH USEFUL FOR TYING WIRE

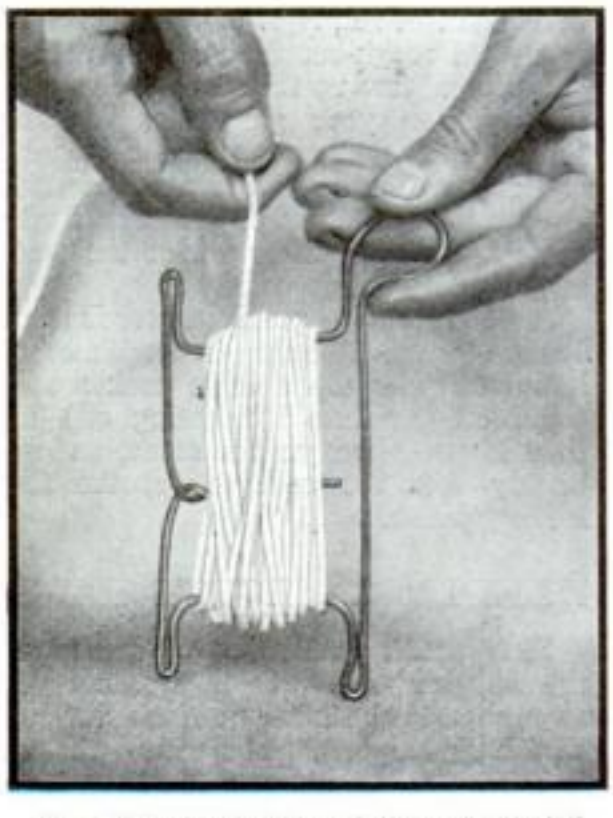
It is not often that a mechanic thinks of tying knots in wire, but sometimes this is the best method. The clove hitch knot illustrated, for example, allows a wire to be fastened to a rod so that there is almost no chance of slipping. With the aid of two pairs of pliers, such a knot can be tied even with fairly heavy wire. If a still more permanent joint is required, solder can be used to unite the sections into one piece. The clove hitch can be used for many other purposes. It is a quick and secure means of closing the tubes on football, punching bag, and other rubber bladders. For tying sacks, it has few equals. Another use is to fasten a number of poles together.—E. W.

PINE CONE DUCK SWIMS WITH HELP OF SOAP

From any well-formed small pine cone you can make a toy duck that will give the appearance of actually swimming when placed in water. Obtain a cone of suitable shape to form the body, and make a split with a knife in the thick end; into this fit the neck and head of the duck, which may be cut from tin. Paint the tin white and add the eyes and a yellow beak. Since it is unlikely that the cone will float upright in the water, drive a screw into the under part for ballast. Then press a small piece of soap at the narrow end of the cone and place the duck on the water. After an interval the bird will start to move over the water in a lifelike manner. The reason is that the dissolving soap lessens the surface tension of the water skin at the rear while at the front this tension remains the same.—S. Leonard Bastin.



Made from a pine cone, this toy duck has a tin head and a screw underneath for ballast

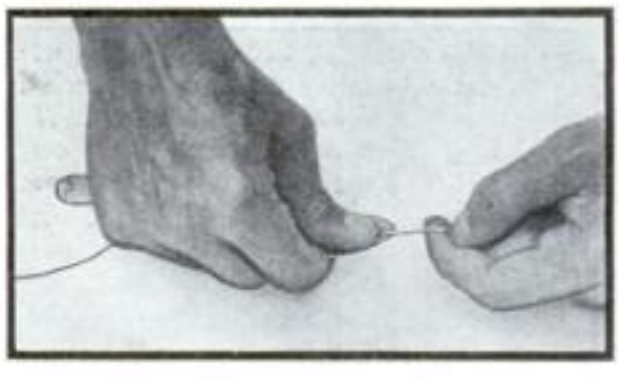


Even if dropped, this reel does not unwind because the "ears" quickly catch on the line

BENDING A WIRE REEL FOR A CHALK LINE

Cords used for snapping chalk lines and similar purposes are usually wound on a long, clumsy stick. This makes them hard to wind, and they often slip out of the fingers and unwind or fall into mud or water. It is better to bend a piece of soft iron wire into the shape shown at the left so that it will serve as a reel for the line. Even if the reel is dropped, it will make only one or two turns in the air before the line catches on one of the "ears." The large eye or loop at one corner is convenient for holding the reel as well as for hanging it up.—W. B. F.

Substantial, easily worked thin wood for planking ship models or other light construction is not always easy to find. If thin three-ply veneer such as is used for many large packing cases is soaked in water, the layers will separate, and the two outer surfaces will furnish thin stock.—W. F.



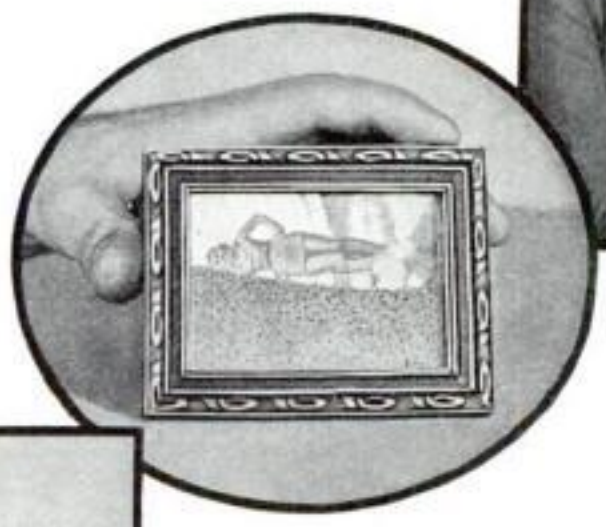
AN EASY WAY TO WAX THREAD OR STRING

Waxing string, thread, or cord with a small lump of beeswax, paraffin, or resin in the usual way is hard on the thumb and index finger. It is much better to place the waxing substance in the end of a teaspoon and draw the cord through it as shown above. The spoon is easy to hold, and in this manner one can apply the preservative to yards of string without the penalty of sore fingers. This is a kink which will appeal to leather workers and also to archers, who have to use much wax when making bow strings.—B. W.

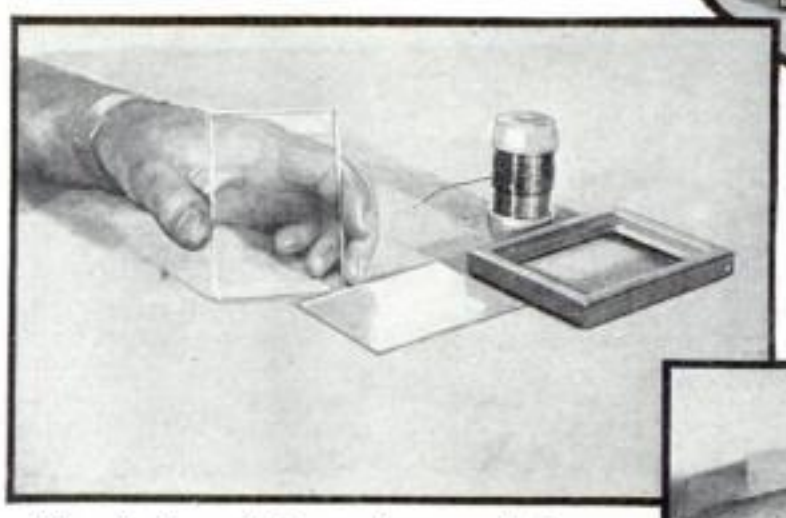
Mystifying Picture Frame Makes Photo Vanish

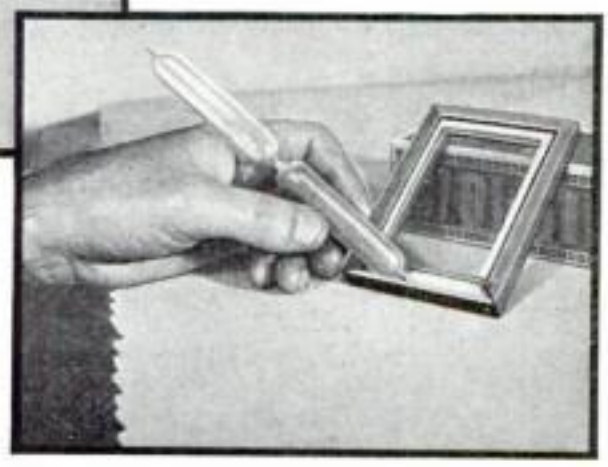
EVEN when one knows the secret, the working of this novelty picture frame seems impossible. Any snapshot placed in it can be made to disappear and return in a startling manner. The action depends on the fact that there are *two* sheets of glass, slightly separated, in the frame. When it is turned upside down, a thin film of fine sand fills the space between the glasses, covering the picture.

The frame illustrated is 3 by 4 in. and cost ten cents. First withdraw the nails from one end and remove the piece of molding. This must be gouged out until it is a mere shell, as it forms the container for the sand. Cut two pieces of extra thin glass from an old glass photographic negative to fit the frame. Hold the sheets apart by means of a U-shaped spacer made from a length of No. 20 copper wire, which leaves one end open for the entrance of the sand; then bind the edges with adhesive tape. Glue the gouged-out molding back in place, and insert only the snipped-off heads of the small nails in their holes. Fill any cracks with household cement. When this is dry, the hollow space may be filled with sand obtained from a ten-cent sand time-glass. This is the only type of sand that works satisfactorily. Now cover the open back of the sand compartment with a strip of thin shim brass and seal the edges with household cement so that the metal is affixed firmly to the frame and also to the picture glass. Make sure that no sand can leak out. A photograph is then fixed in place, and the entire back of the frame is covered with a sheet of brown paper or imitation leather.



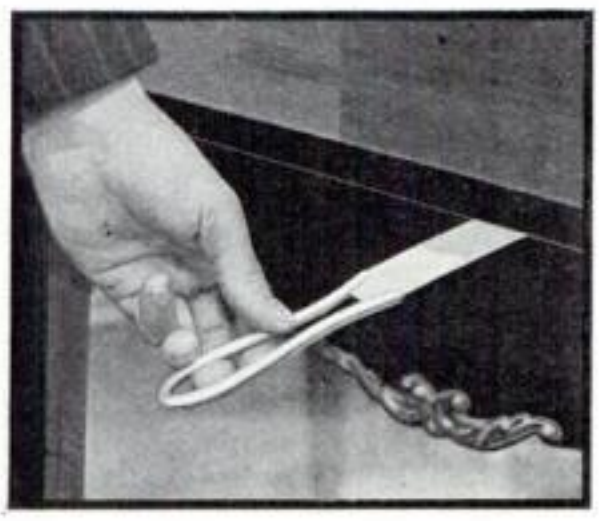
The frame has two glasses which are separated only by the thickness of a piece of No. 20 copper wire. Fine sand can be made to flow between these glasses merely by turning the frame.





Above is shown the frame, glasses, and wire. At the right, the secret hollow space gouged out in the frame is being filled with very fine sand taken from a ten-cent time-glass.

If this is done correctly, the sand fills the space between the sheets of glass completely when the frame is tipped, and it runs quickly back into the compartment when the frame is turned right side up. The photograph above shows the sand covering half of the picture. To make the picture appear and disappear mysteriously, the front of the frame should be momentarily turned away from those viewing the stunt during the second or two required for the sand to pass to and from its concealed compartment. Give the frame a slight shake when turning it over. Skill in demonstrating the trick can be acquired with five or ten minutes of practice.—KENNETH MURRAY.

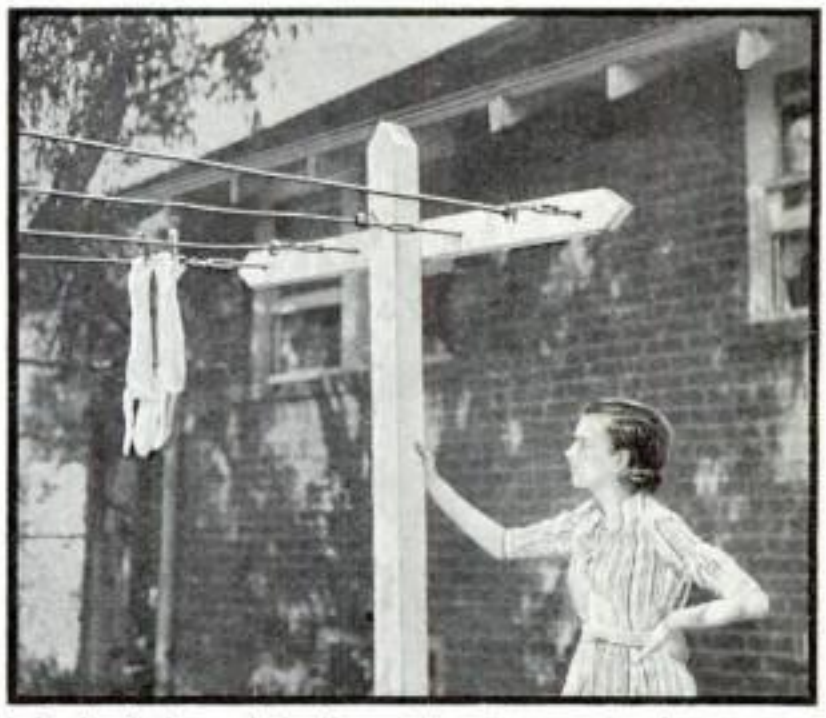


KITCHEN SPATULA OPENS OVERCROWDED DRAWER

CARDBOARD boxes, books, and other bulky objects in an overcrowded drawer often accidently shift around in such a way that the drawer cannot be opened. At such times it is always difficult to find something that is at once thin enough to enter the crack at the top of the drawer and strong enough to press down the obstruction. There is nothing better for this than the common kitchen spatula. It is thin enough to enter a very narrow opening, yet sufficiently stiff to hold down the misplaced object long enough for the drawer to be pulled open.—F. W. B.

TURNBUCKLES TIGHTEN CLOTHESLINES

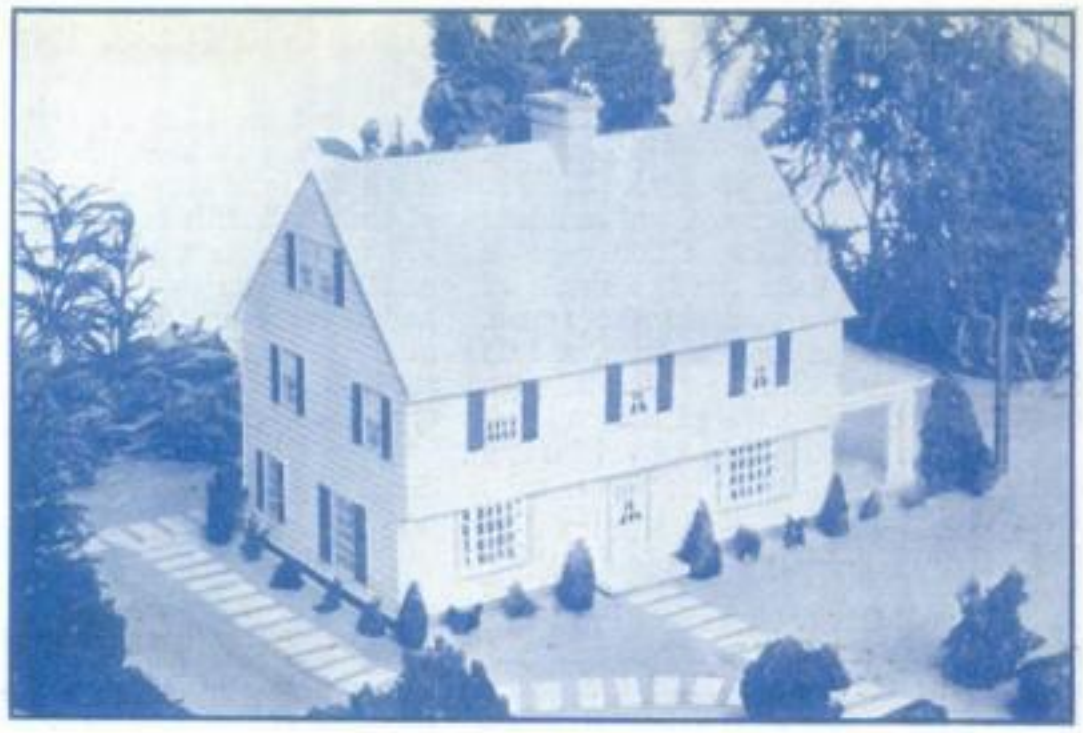
FOR clotheslines of the type illustrated, a tightener can be made cheaply from a few fittings obtained at a hardware store. The end of the clothesline is fastened to the eye at the end of the left-hand thread of a small turnbuckle by means of a wire clamp. A threaded rod about 12 in. long is screwed into the other end of the turnbuckle. The projecting end of this rod is passed through a hole bored in the cross arm on the clothesline pole, and secured by a washer and nut on the opposite side of the arm. The clothesline then can be tightened either by turning the turnbuckle or by tightening the nut at the end of the rod. The two methods together give an adjustment of about 12 in., which will allow the ordinary slack to be taken up.—IVAN E. HOUK.



Each of these clothesline tighteners consists of a small turnbuckle extended at one end by means of a threaded rod.

A DUST pan or crumb tray makes a good shield for painting around window lights and in other awkward places.—H. J. B.

Cash Prizes for building Your Home *in* Miniature



. . . . . EITHER THE HOUSE YOU LIVE IN NOW OR THE ONE YOU HOPE SOME DAY TO OWN

HOW would you like to make a model of the house you live in, or the one you hope to build some day? You will find the work much easier than constructing a ship model, a coach model, or almost any other kind of model, and the finished product will certainly have more personal significance.

To promote a friendly competition among readers as to who can build the best model of a house, POPULAR SCIENCE MONTHLY will award six prizes as follows:

First prize	$ 50
Second prize	25
Third prize	10
Fourth, fifth, and sixth prizes, $5 each	15
Total prizes	$100

The conditions of this contest are given on the following page.

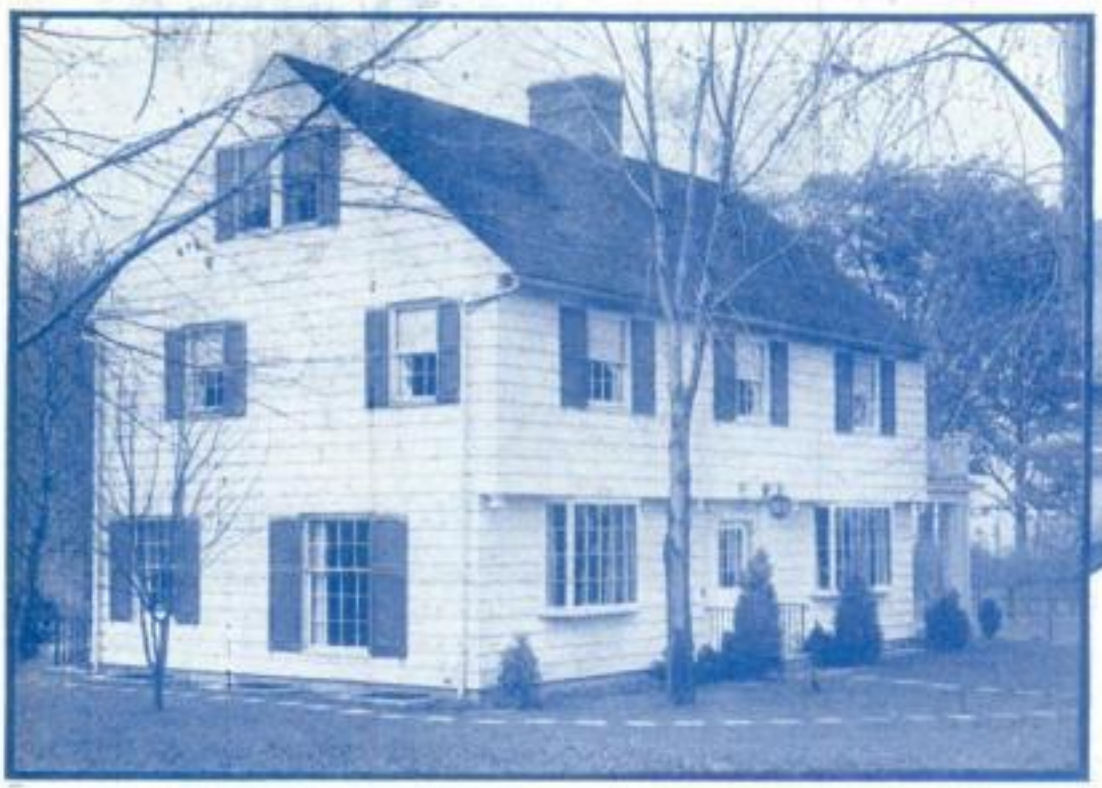
If you will study the accompanying illustrations, you will see how to go about building a cardboard house model, although you may use wood, metal, soap, or any material you wish. This particular model was constructed by Charles A. King from plans and photographs of the home of George William Teare published in our recent series of architects' homes (see P. S. M., May '31, p. 76). Mr. King also prepared the notes on house model building which follow.

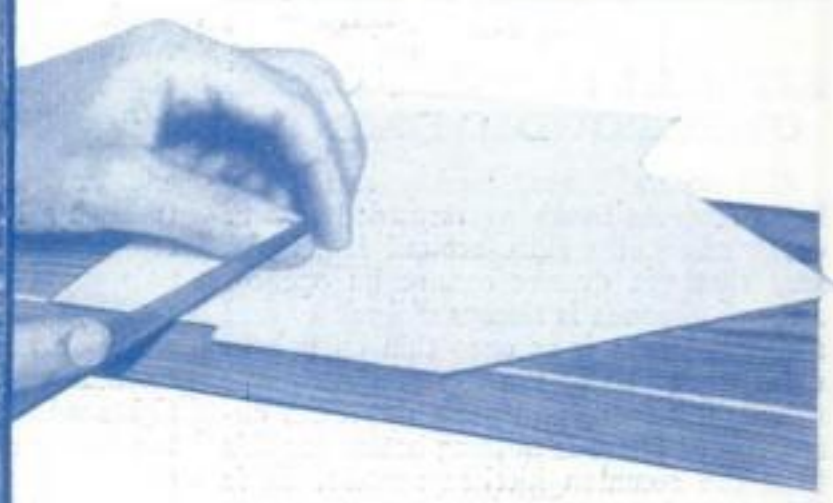
The general principle of making an architectural model is to draw the front, back, and sides (commonly called the elevations) on cardboard. These are then cut out and glued together, and the roof and various accessories are added. The necessary outlines can be transferred directly from the architect's plans, if available; otherwise the elevations have to be drawn to scale before the model is started. A convenient scale to use is ¼ in. equals 1 ft. The model shown above was constructed on this scale, its over-all dimensions being about 9 by 14 in. A smaller scale is not recommended, and a larger one is unnecessary unless the model is to be used as a doll house or for special display purposes.

If the completed house is to be white, the elevations may be made of rather stiff white cardboard. Illustration board is excellent. Clapboards, shingles, casings around openings, corner boards, sash lines, and other details may be suggested with pencils or with a ruling pen and drawing ink and be shaded to suggest depth, if desired. A second method is to cut all window and door openings with a thin-bladed, well-sharpened shoe knife or a thick-backed razor blade. A third treatment is to draw the sash lines with ruling pen and white ink on small rectangles of black paper and paste them on the cardboard where the windows are to appear. Strips of cardboard may be glued on to indicate the casings. In making a very small model, a narrow strip may be used as at *A* in one of the drawings on page 83 to suggest the division between the upper and lower sash; and the curtains may be indicated, if desired.

If the house is to be painted in colors, the openings may be outlined, the elevations fitted and assembled, and then the whole painted with decorators' water colors (calcimine). The casings may be trimmed a different color. Another method is to give the cardboard elevations a coat of shellac and paint them in oil colors.

While the elevations may be assembled merely by gluing the corners together, a floor of fiber wall board cut the shape and size of the house will make the model more substantial. For neatness, the elevations should be mitered at the corners.





Compare this photograph of Mr. Teare's beautiful home with the model of it illustrated at the top of the page. In the view immediately above is shown the process of beveling the edges of one of the side walls of the model

Lay each of them face down upon a smooth, straight board so the corner coincides with the straight edge, and use a sharp double-cut smooth file to cut the edges to a miter. Stop just short of a feather edge.

Place the wall board floor on a flat surface—a drawing board, for example—push two or three pins through it or lay a weight on it, touch one edge with thick liquid glue, place the corresponding elevation against it, and hold it there with a book or with pins pushed slantingly into the edge of the wall board. Repeat with adjoining elevations, and at the same time touch each mitered corner joint with thick glue. Hold each joint in place a minute or two with pins or otherwise until the glue sticks. Reënforce the corners inside by gluing cardboard triangles in place as at *A* in the lower left-hand photo on this page. The use of adhesive paper tape in the corners will also help. The elevations may be strengthened by fitting pieces of pulp board as indicated by the dotted lines *B* in the same photograph. Porches and other projections should be glued on after the main house is assembled.

In building the model shown at the top of page 82, a slightly more complicated method was used. The same type of wall board floor formed the foundation, but second and third floors of medium weight pulp board were added as shown in the lower right-hand photo on this page. The posts of the porch and of the kitchen entry were made of soft pine.

Details like iron railings at the front entrance and the wooden balustrade around the deck above the porch of the original house were omitted.

The top floor was glued in place, the gables braced, and the house made ready for receiving the roof, which was cut from medium weight pulp board. The shingles were indicated by parallel lines drawn with a chisel-pointed 4B pencil. The chimney was made of pulp board, the ornamental brickwork being suggested by strips of the same board.

The brick underpinning was made as follows: The model was placed upon a piece of pulp board and a pencil mark made around the outside. Strips of wood about 3/16 in. thick were cut and glued to the pulp board a scant 1/8 in. within this line. Then the pulp board was trimmed to the line, and a 3/16 in. thick strip of the same board was fitted and glued around the edge of this foundation and colored to suggest brick. Thick glue was placed at intervals on the top of the underpinning, and the house laid upon it so the shingled sides projected about 1/16 in.

A piece of wall board about 3 ft. square was placed on a table, the model tried in various positions, and a scheme of landscaping thought out and indicated on the wall board with pencil lines. Shrubbery, trees, and plants were made by tearing—not cutting—some old sponges, and buying other small rubber "sponges" at the five-and-ten-cent store. These were colored different shades of green. The trees were prepared by pushing small stems of maple, birch, and willow into the sponges and fastening other sponges to them with pins. The hedges were made of pieces of stale bread, torn and cut into shape, and colored a deep green to simulate arbor vitæ or other evergreens.

How to Enter the HOUSE CONTEST

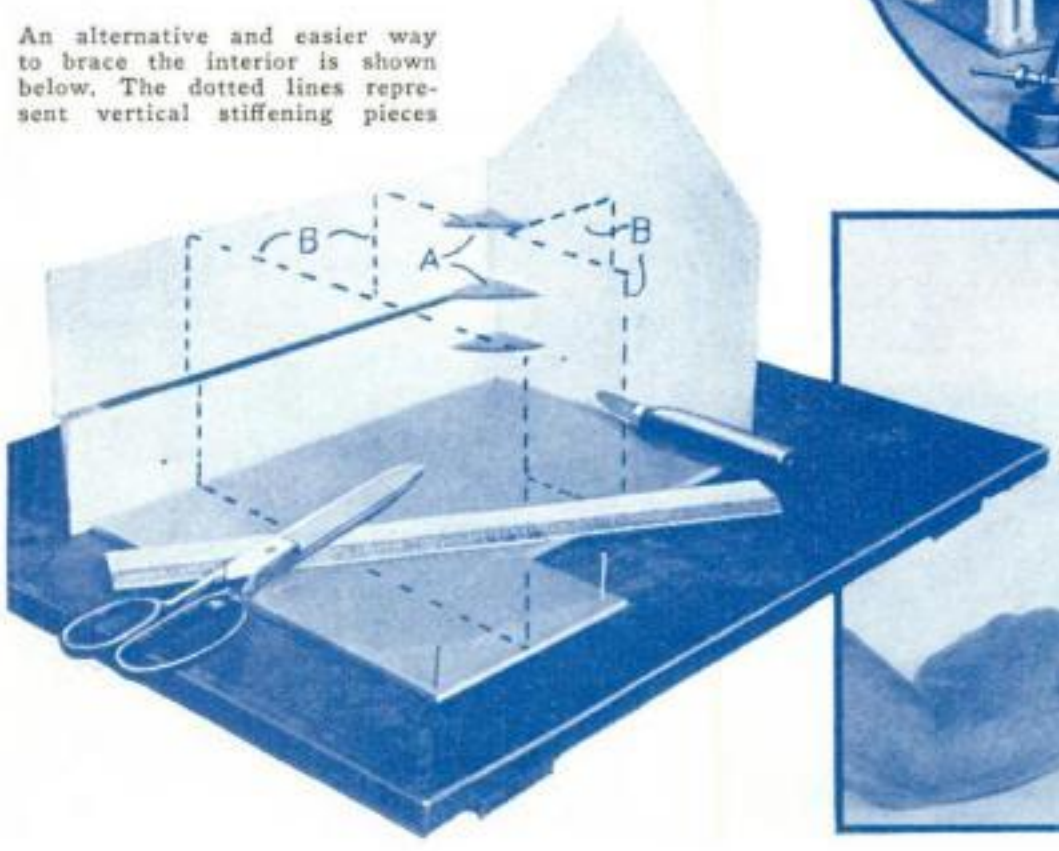
ALL you have to do to enter the contest is to build a model of the house you live in or the house you hope some day to own, using any materials, methods, or scale you wish, and mail at least two large clear photographs of it to the House Contest Editor, POPULAR SCIENCE MONTHLY, 381 Fourth Avenue, New York, on or before December 31, 1931. On the back of one of the photographs, or on a separate sheet of paper, give the scale to which the model was built, its approximate dimensions, and the material of which it is mainly constructed. State whether the model is of an existing house or one you hope to build.

Each entry will be judged on (1) its general attractiveness and (2) the quality of craftsmanship. In case of ties, each tying contestant will be awarded the prize tied for.

The contest is open to all except employees of POPULAR SCIENCE MONTHLY and their familes. Only one model may be entered by each contestant. The judges will be the technical and home workshop editors of POPULAR SCIENCE MONTHLY, and their decisions will be final. They will have the right to ask any contestant to send his actual model to New York for their inspection, with the understanding that it will remain his property and be returned.

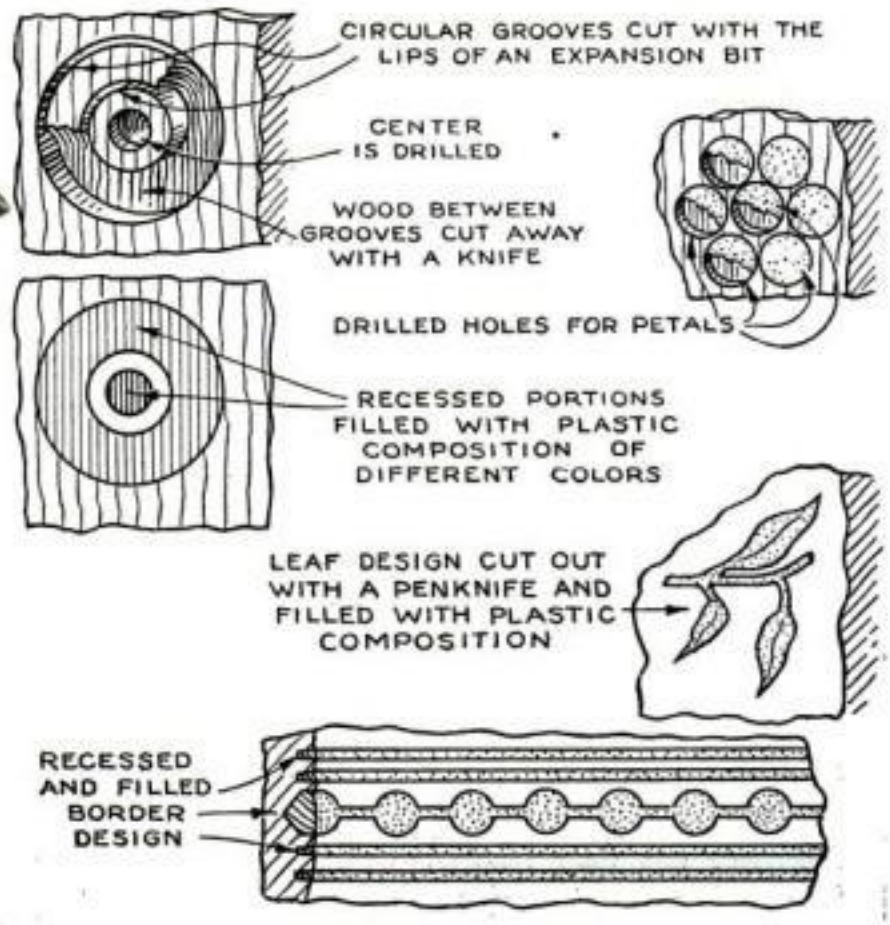
Three simple methods for treating windows are suggested above. At the right is Mr. King's model as it appeared when ready for the roof; and the photograph immediately below it shows how the interior supports were assembled

An alternative and easier way to brace the interior is shown below. The dotted lines represent vertical stiffening pieces



Composition Wood Gives Excellent Inlaid Effects

Table lamp turned from wood and decorated with inlays made by pressing a high-grade composition wood paste into grooves and small recesses. The method followed is shown in the drawings at right

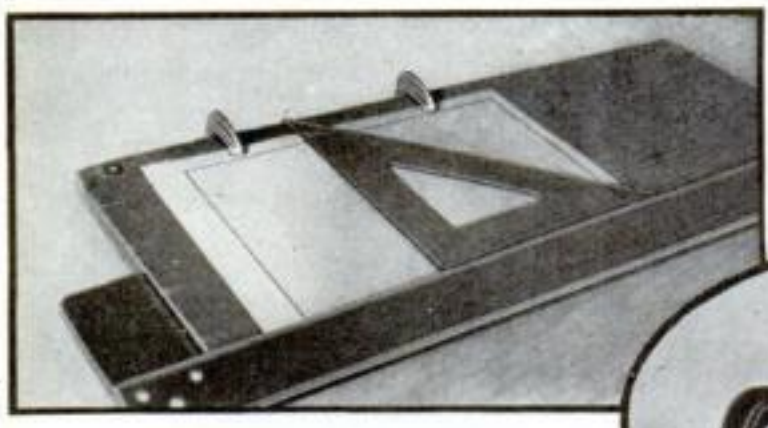


Much of the floral design was worked out by drilling holes of various sizes in the wood

INLAYS of excellent appearance can be made by cutting the desired design in the wood and filling the cavities with a high-grade plastic composition or wood putty. These plastic materials are ordinarily sold in a natural wood color, but they can be stained to match any wood and, if necessary, tinted in bright, light hues with artists' oil colors or pigments ground in oil. They also can be purchased already stained in a variety of colors. In turning the lamp illustrated, I cut several grooves ⅛ in. deep and of various widths at appropriate places. Next I drew a spray of flowers around the body of the lamp and recessed them by using twist drills, an expansion bit, and a pocketknife. The accompanying sketches offer some suggestions. In cutting grooves with an expansion bit, I turn it backwards so that the screw will not pull it too deeply into the surface of the wood.

When placing the plastic composition, be sure to press it down firmly. After it has hardened for twenty-four hours, the surface can be smoothed with sandpaper and finished as if the inlays were of natural wood. Even on close inspection it is difficult to tell this kind of work from genuine inlaying, especially if there are no very large areas where the inlays might look flat and lifeless. Borders on table tops, panels, and drawer fronts are easily made by this method. It is important, of course, to see that the grooving plane or other tools used are sharp and in good condition.—ARCHIE AMOS.

DRAWING PAPER HELD WITH C-CLAMPS



For holding special drawings, these clamps replace thumb tacks—for example, when additions have to be made to a drawing which has already been trimmed

THE drawing paper holders illustrated enable paper to be attached to the board or to be removed and replaced without making thumb-tack holes in it. This is an advantage in any type of drafting where the holes would be a blemish. Two small C-clamps of an inexpensive type are used, and a U-shaped clip of spring brass or bronze is soldered to the back of each clamp. These clips slip over the edge of the drawing board so as to hold the clamps at points on the board corresponding to the size of the paper being used. They also allow the clamps to be quickly removed from the board when it is not in use. It is well to solder a piece of sheet metal about ⅜ by ½ in. to each tip that presses on the paper; this will prevent the tip from making dents in the paper. If long sheets of paper are being used, a third clamp may be placed at the center of the top edge.—R. W. WAGNER.

LEAK IN TANK STOPPED WITH BOTTLE CAPS

IF A HOLE is accidently punched through an open tank or other light sheet metal container, especially where there are no facilities for soldering, it is possible to make an emergency patch from two soda water bottle caps. Remove the cork inserts, punch holes through the metal caps for a bolt, and use the cork pieces as gaskets and the caps as washers.—F. B.

RULE SERVES AS PULLER FOR SMALL FUSES

REMOVING and replacing small fuses such as those used on automobiles, motorboats, or equipment of the U. S. Navy is difficult when only the fingers are used. The best way of handling these small fuses is to make a puller from a section cut from an old four-fold carpenter's rule, as shown in the photograph above. The tool consists merely of two short legs cut from one of the outer joints—not the central joint—of the rule. These legs are hinged at one end and bear grooves at the other to grip the fuse. The grooves are cut with a round file of suitable size. It will be found that this puller is far superior in convenience to fiber pliers and other devices commonly used. If a brass-bound rule is used, obviously the binding must be removed for about the distance shown in the photograph above.—V. A. LYMAN.

after exposure guard against

SORE THROAT

gargle Listerine every 2 hours

reduces risk of COLDS 50% tests show

Under normal conditions of living, the twice a day gargle with full strength Listerine is sufficient to aid Nature in keeping the millions of germs in the mouth under control. It helps to ward off colds and similar infections.

Exposure weakens resistance

But after a late season football game, in fact after any severe exposure, more frequent gargling is advisable. Once every two hours is recommended by authorities on oral hygiene.

Body resistance is lowered by cold hands and feet, sudden changes of temperature, and long exposure to cold. So Nature needs extra help in conquering the disease germs breeding in the mouth. Listerine kills germs in record time.

Garglers have half as many colds

You can realize the great value of using Listerine *daily* by noting the results of careful cold control tests conducted under medical supervision. The results:

Those who gargled Listerine twice a day had half as many colds as those who did not gargle.

Those who gargled Listerine five times daily had one-third as many colds.

And in each case the colds were less severe and of shorter duration.

Avoid harsh antiseptics

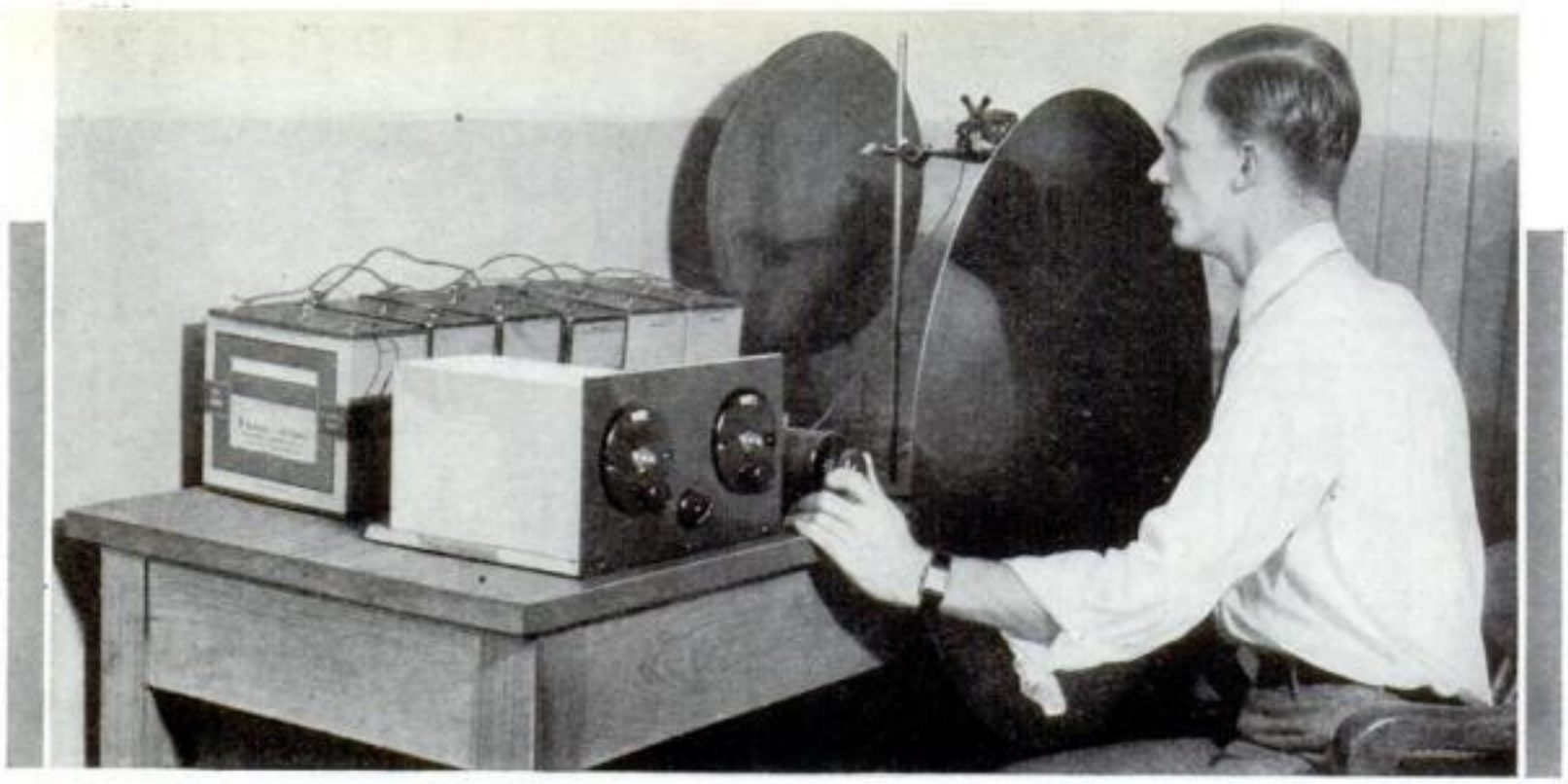
Such success is due to two properties of Listerine. Both are important to you.

1. Its rapid germicidal action. Listerine kills germs in the fastest time which can be accurately measured. Reduces mouth bacteria 98%.

2. Its healing effect on tissue. Listerine has none of the irritating qualities present in mouthwashes so harsh they require dilution.

Keep Listerine handy in home and office and use it regularly. Remember, it is the *safe* antiseptic which not only combats infection but overcomes bad breath. Lambert Pharmacal Co., St. Louis, Mo.

SAFE ..LISTERINE.. PLEASANT



The author adjusting the disk speed on his five-tube television receiver

How to Complete Your Television Receiver

By GEORGE H. WALTZ, JR.

"DID you happen to see this?" Don Marshall asked as he sat down in one of the wicker chairs on our porch and handed me a long newspaper clipping. "I noticed it in today's paper."

The headline on the clipping read: "S. S. LEVIATHAN AT SEA IN TELEVISION TEST; *Television Receiver on Board Vessel in Mid-Ocean Picks Up Images from Washington and Boston Stations.*"

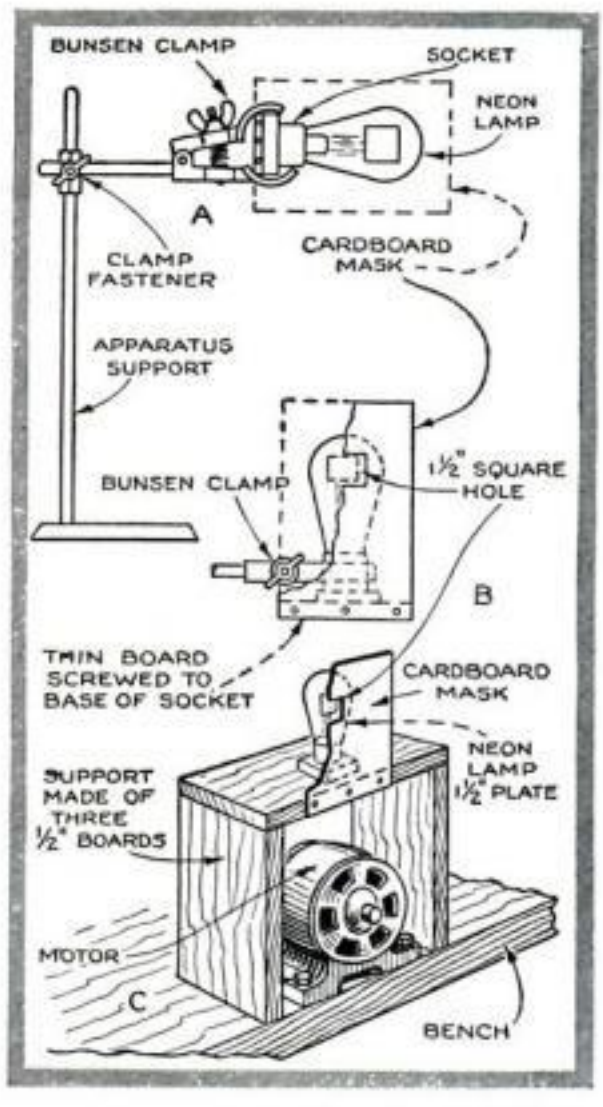
"Interesting, isn't it?" said Don, who is a veteran radio experimenter, as I finished reading. "Television may be a long way from perfection but it certainly has reached the point where it's getting a lot of public notice. Incidentally, how is your television receiver coming along?"

"Not so good Don," I confessed. "It's the same old story. I don't know just how to go ahead. I've painted the disk with flat black and cleaned out the holes by running the drill through, but I'm puzzled about the next step. If you've got some spare time, I wish you'd show me how to mount the neon lamp and connect up the motor."

He followed me to the basement, and as I switched on the lights I reminded him that the last time he had been in to give me a hand we had finished assembling the receiver (P. S. M., Oct. '31, p. 82).

"Then all that's left is to assemble the scanner and rearrange the last stage on the amplifier so as to obtain a C-bias voltage regulation for the neon lamp," Don said.

"You mean to say we haven't finished messing around with the wiring yet!" was my somewhat disgusted reply. "I thought we finished the receiver last time."



At left: Three ways of mounting a neon lamp. The mask and the lamp should be placed close to the disk

"So we did," Don rejoined grinning, "but now that we're going to hook in the neon lamp we must make some provision for controlling the definition and contrast of the image. It's a simple change."

With this Don hurriedly sketched out a wiring diagram and started explaining what it all meant. "You see," he began, "in order to get the best results we have to supply some means for regulating the quality of the image. This can be done by regulating the C-bias voltage. Up to the resistance which I have marked *Z*, the circuit for the amplifier is just the same as we have it at present (see drawing P. S. M., Oct. '31, p. 82). Now, instead of bringing the lead from the resistance *Y* down to our -C terminal, we connect in a ten-thousand-ohm, wire-wound potentiometer marked *A*, one forty-five-volt B-battery, and a small twenty-two-and-a-half-volt B-battery. Do you follow me?"

"As far as you've gone, yes," I replied, "but what's that condenser marked *B* doing in there?"

"That two-microfarad condenser," Don explained, "serves as a current reservoir and maintains the flow of current during any possible breaks in the circuit caused by the slider as it moves from one wire to the next."

"In other words," I interrupted, "since it is connected across the C-bias, it stores up current when the slider is in contact and gives off this current when the slider is not in contact."

"That's right," Don agreed. "Now, in order to allow you to change quickly from your loudspeaker *F*, which you will use to tune in the signal, to your neon lamp *E*," he continued, "we must put in the double-pole, double-throw switch *G*. The iron-core choke *D* and the condenser *C* serve as a by-pass for the plate current, which, with two hundred and fifty volts, would be likely to burn out the speaker windings."

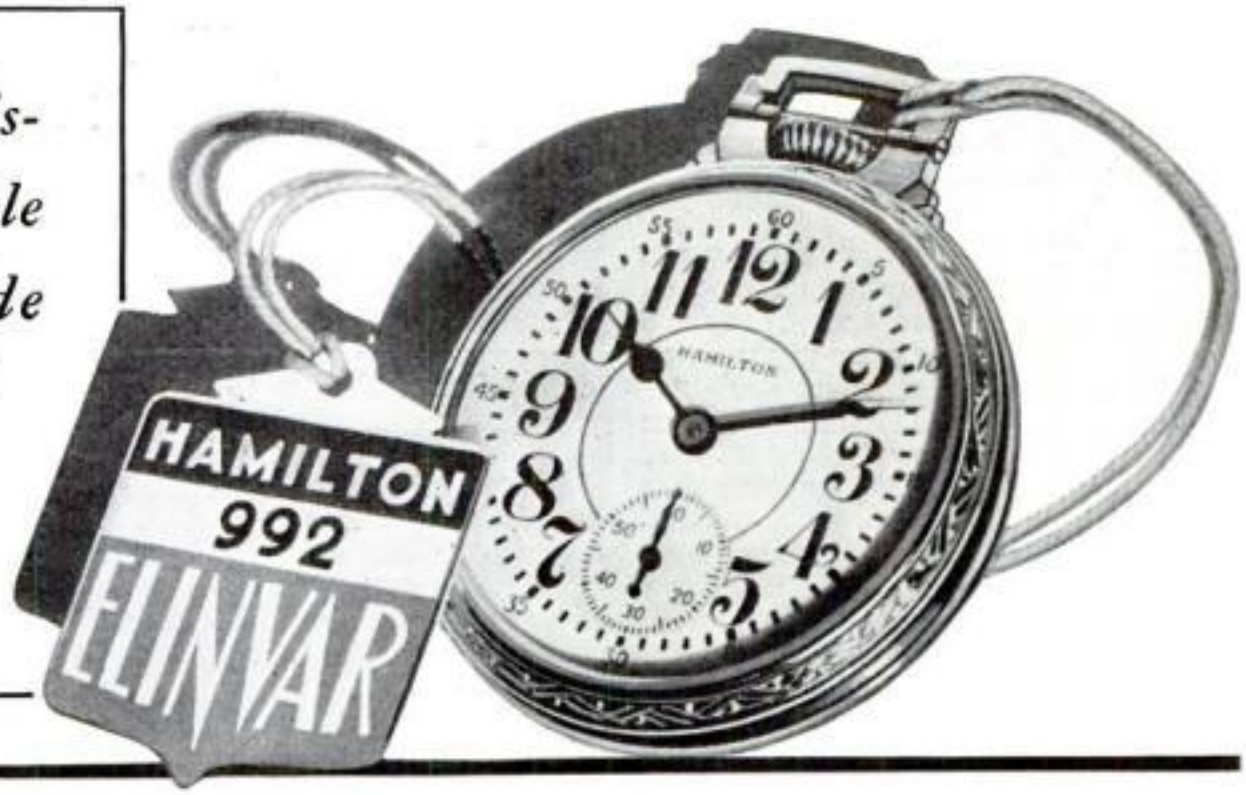
"I thought you said that there wouldn't be many changes," I said jokingly.

"Well, I'll tell you what we'll do," Don

HIS STARTLING DISCOVERY

was hailed as a TRIUMPH OF SCIENCE!

Today . . . that discovery makes possible the first high-grade antimagnetic watch made in America!



HAMILTON "992" ELINVAR

Dr. Charles E. Guillaume, Director of the International Bureau of Weights and Measures, who won the Nobel Award in Physics for his discovery of Elinvar.

ELINVAR was truly a triumph of science! Its discovery brought to Dr. Charles Edouard Guillaume world-wide acclaim.

Watchmakers, especially, hailed it as a significant event. For centuries no metal had existed that was ideal for hairsprings. Here *was* one. A rustless steel alloy that could not be permanently magnetized—whose elasticity would not vary in changing temperatures!

Here, indeed, was a metal that promised to revolutionize the art of watchmaking. It has. Elinvar has brought about the first important change in the mechanism of a watch since the invention of the bimetallic balance wheel—165 years ago!

It has enabled the Hamilton Watch Company to perfect a new railroad watch that is a marvel of accuracy under widely varying conditions.

Hamilton "992" Elinvar is that watch. This watch has the new, rustless steel alloy—Elinvar—in the hairspring and a new, rustless, non-magnetic monometallic balance wheel.

Here is a watch that tells you accurate time even after exposure to strong magnetic fields. Here is a watch that is practically unaffected by temperature changes. Here is a watch whose vibrating heart is free from Rust!

Here is, in fact, a watch that is a monumental forward step in securing accurate time. We urge you to see it as soon as possible.

Did you know that watches often perform erratically after having been carried in ELECTRIC TRAINS?

. . . or in any plant or building where electric power is generated by whirling dynamos? Magnetism does it—and ever since watches were first made, this force has been the greatest enemy of their accuracy. Do you know how temperature affects your watch? Send for our FREE BOOKLET and read the fascinating story of the queer things that affect watches, and how the discovery of "ELINVAR"—a new steel alloy—brings about the greatest development in watchmaking in 165 years, and promises the most accurate watches ever made.

Send for this

FREE BOOKLET

Learn how hairsprings and balance wheels of watches are made. This booklet is illustrated by unusual photographs and photomicrographs of watch mechanisms. Use coupon—send for it today—it's FREE.

HAMILTON WATCH COMPANY
992 Wheatland Ave., Lancaster, Pa.

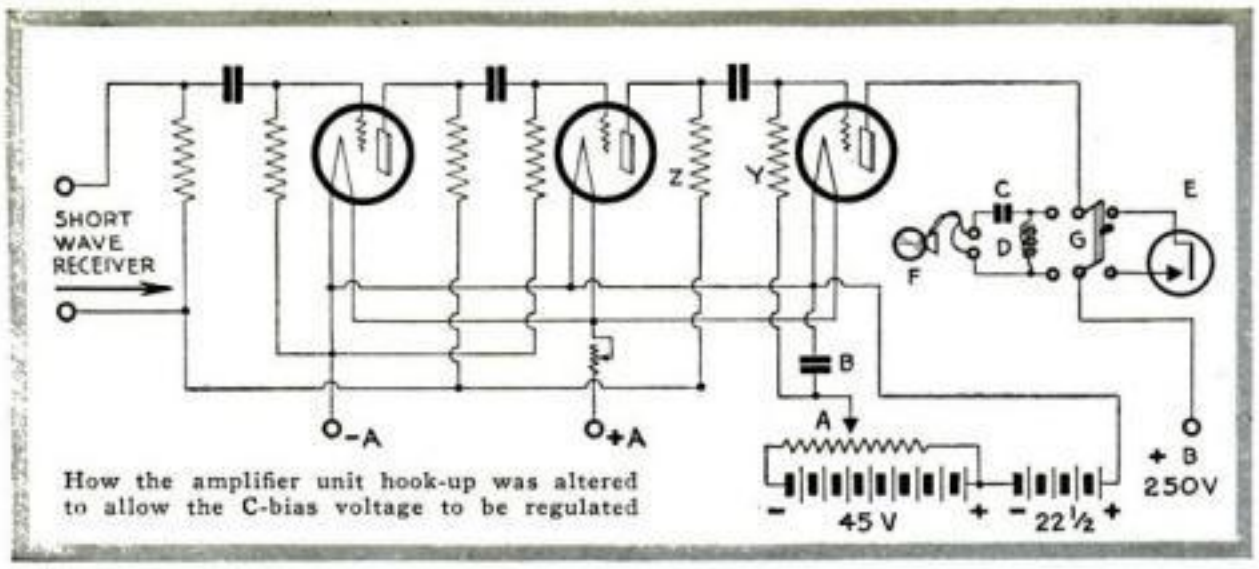
Please send me a copy of your **Free Booklet** —"Elinvar in your Watch."

NAME_____

OCCUPATION_____

ADDRESS_____

CITY_____ STATE_____



How the amplifier unit hook-up was altered to allow the C-bias voltage to be regulated

suggested. "I'll sketch out several ways for you to mount your neon lamp and show you how to connect up your variable speed motor, and then while you're doing that I'll change your amplifier hook-up."

When Don had finished sketching (see drawing on page 86), we both started at our appointed jobs. After studying over Don's suggestions for the neon lamp support, I decided that since I had the Bunsen clamp, clamp fastener, and support on hand in the assortment of apparatus I used on my chemistry bench, I'd use the arrangement shown at *A*. I figured that, besides being the easiest method, it had the advantage of allowing for horizontal and vertical adjustment. Later on, when I wanted to mount the set in a cabinet, I could use the variation at *C*.

Working together, we soon had the parts all ready and assembled. As the last connecting wire on the batteries was placed, Don began explaining the procedure in tuning in a station.

"First," he began, "we throw the double-pole, double-throw switch to the speaker side, turn up our tube rheostats, and then turn the dials on the receiver slowly until we pick up the buzz-saw television signal of some station. Then when we have regulated the condensers and rheostats to get as loud a signal as possible, we throw the switch to connect in the neon lamp."

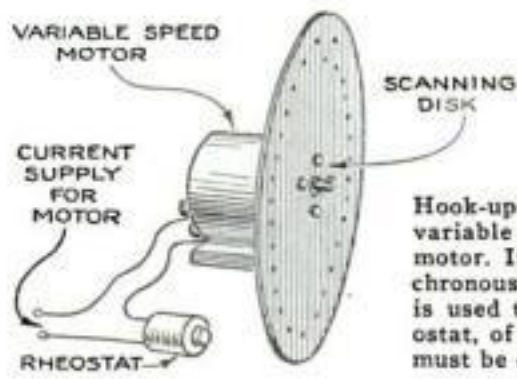
AS HE talked, Don went through the operations. As he threw the switch connecting in the neon lamp, I noticed that the plate of the lamp gave off the familiar pinkish glow I had seen when I visited the television studios of station W2XCR (P. S. M., July '31, p. 16). Don was watching the disk.

"Now that the set is in operation," he said, "the main problem is to get the disk to revolve in synchronism with the disk at the transmitter. We do that by regulating the speed of the motor with the rheostat so that it is just a bit in excess of the speed of the motor at the transmitter, which is, in sixty-line scanning, twelve hundred revolutions a minute, and then by using the thumb of the right hand as a brake, we slow down the disk just enough to obtain the right speed."

"How do we determine the speed?" I asked. "With a tachometer?"

"If you want to," Don replied, "but the simplest way is to watch the image space. When the speed is wrong, all you'll see will be a jumble of spots and streaks. Then all you do is increase the speed until you see a distorted image which will slant off, first to one side and then to the other. Then, by slowing the motor down a trifle with your thumb, you can bring the disk into synchronism. When you've done this, the image will settle down. However, the image you obtain," he continued, "may be out of frame. That is to say, instead of seeing one complete picture you'll see half of one image and half of the image directly following it. If this is the case, increase the thumb pressure so as to slow down the motor appreciably and then proceed to synchronize over again."

When Don had finished explaining, he shut off the motor. "Here, try your hand



Hook-up for the variable speed motor. If a synchronous motor is used the rheostat, of course, must be omitted

at it yourself and see what kind of an image you can bring in," he said.

I seated myself in a position where I could manipulate the motor rheostat and also conveniently adjust the pressure of my thumb against the disk.

"Careful!" Don warned as I turned up the motor rheostat. "You'd better use this old garden glove of yours to protect the thumb you're going to use as a brake."

As I turned up the rheostat, I noticed spots and brilliant streaks speeding back and forth across the image space. As the speed increased, the spots and streaks slowed down, and a distorted image, which first slanted off to the right and then to the left, appeared. I placed my thumb against the edge of the disk. As I did so, the faint, side-slipping image turned again into a dazzle of streaks and spots. This told me that I had slowed the motor too much, so I decreased the pressure. After a dozen or so trys, I succeeded in getting the image to stand still. As I studied it, I saw that it was printing.

"Well," Don asked, "what've you got?"

"I've got some printing," I replied enthusiastically, "but it seems to be upside down. What causes that?"

"Is the image black on white, or white on black?" Don asked.

"It's black on white just like a newspaper," I replied, "but it's printed upside down."

"The sign's all right," Don explained, "but your disk is mounted on the motor backwards and is placing the spots of light in the wrong order. Shut off the motor. We can remedy that in a jiffy.

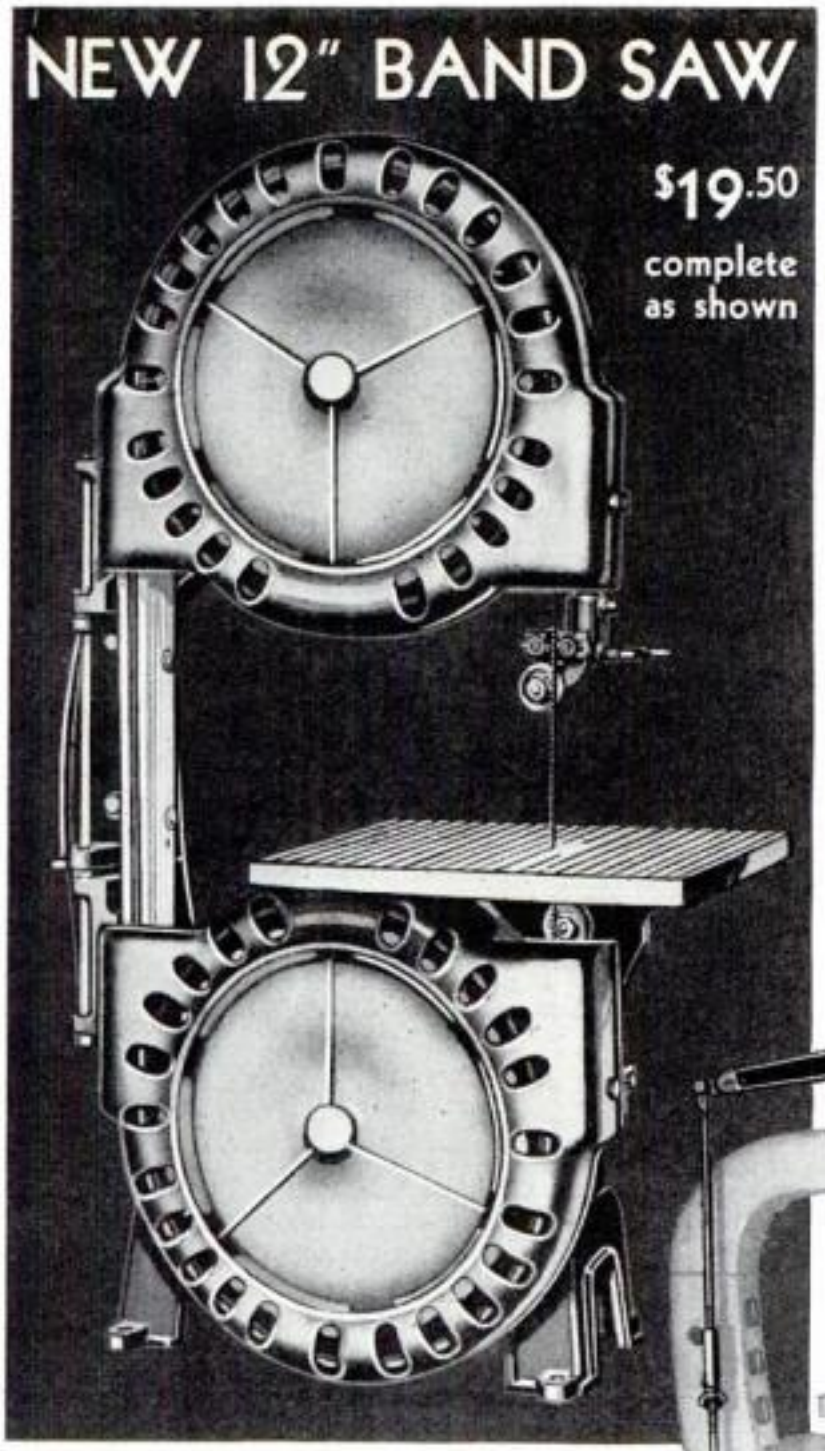
"You see," Don went on as he removed the disk from the shaft and turned it around so that the face which was turned toward the motor was now facing forward, "the holes in this disk weren't passing by the plate of your neon lamp in the same order as the holes in the disk at the station. In other words, when the first hole at the outside of the spiral on the transmitting disk was passing the upper left-hand corner of the picture area, the last hole at the inside end of the spiral on your disk was passing a point at the lower left-hand corner of the plate in your neon lamp. Your disk was assembling the units of the picture upside down."

"Oh, I see," I said as the explanation finally filtered through. "Then by reversing the disk as you have done, the spiral in my disk will be revolving in the same manner as the one at the transmitter."

"That's right. Believe me, you're lucky you didn't find more wrong than that. And you know," Don continued, "if you want to, you can use a synchronous motor for the local stations operating off the same power line that supplies your house. Then you won't have to synchronize with your thumb. Many times, even if the station is not on the same power line, the current is held so close to sixty cycles that you can use a synchronous motor with fairly good results."

This is the fifth article in Mr. Waltz's television series, which began in the July issue. Another television article is scheduled for next month.

In order to eliminate reflections, a coat of flat black paint was applied to the surface of the scanning disk



You Can Be THRIFTY
without sacrificing quality

EVEN before thrift became the watchword in home and shop, "Driver" Power Tools were preferred by a majority of men who do woodworking for pleasure or profit.

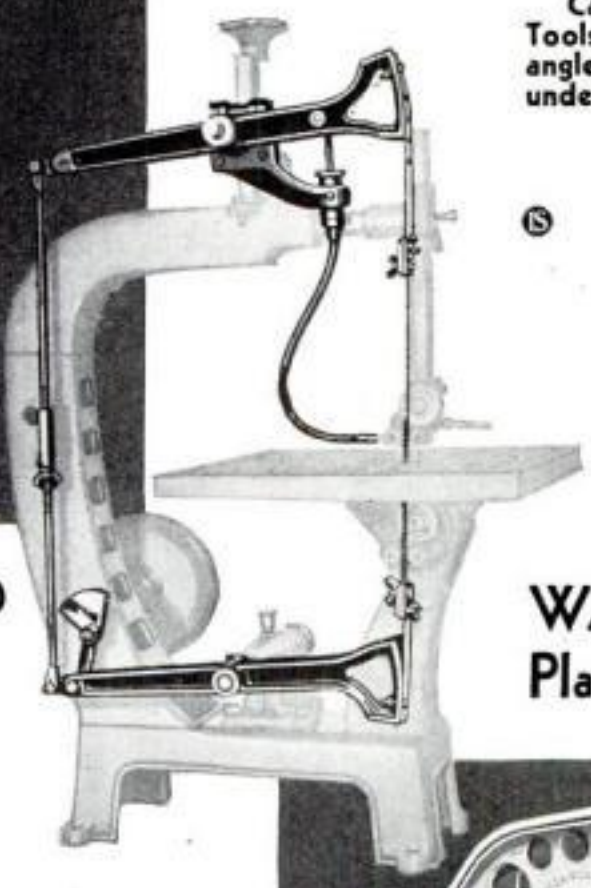
Every year thousands are equipping with "Driver" Power Tools because of their modern, ingenious design, their genuine outstanding value.

No expense is spared to make every "Driver" machine the leader in its class. That "Driver" tools are, at the same time, unusually low in price, is due to the universal acceptance they enjoy... a fact that permits volume production and distribution—the two factors essential to low costs.

As an example, consider the new "Driver" Band Saw. Many months of skillful, expensive effort were spent in designing and perfecting it. Engineers and men skilled in mechanical development will marvel at its standard of excellence. Craftsmen and others who are interested more in what this machine will do than in how it is built, will be enthusiastic about its even, powerful action, smooth cutting, freedom from vibration, and all-round efficiency.

Its weight (72 lbs.), its height (34 in.), its capacity (6 in. stock), its bearings (⅝ in. diam.), and its unique tensioning device and roller guides together with other features place this saw in a class by itself—a new contribution of "Driver" engineers.

Call at your local store and see "Driver" Tools in action. Inspect them carefully, from every angle. Compare them to others. Then you will understand why it's thrifty to be a "Driver" owner.



Ⓢ

FREE

Get this free folder on new "Driver" Tools from your chain store, mail order house or hardware dealer. If more convenient, write us.

JIG SAW ATTACHMENT—$4.50

Converting a band saw, in a few minutes, into a "super" jig saw may be a bit unusual but it is entirely practical. In fact a few inexpensive parts will give you an entirely new idea as to what a jig saw can do. The roller guides insure an absolutely true-running blade. Blades from the finest to the coarsest may be used. A novel feature is the positive blower—keeps work cleared.

WALKER-TURNER CO., Inc.
Plainfield New Jersey

NEW 7" BENCH SAW

Greater capacity, increased weight, improved design, and easier, simple control—are all combined in this new "Driver" Bench Saw. Any wood up to 2¼ inches may be ripped or cross-cut either straight or at any angle up to 45 degrees. Removable table insert for grooving, sanding or surface grinding.

The arbor comprises a frictionless bearing with a "knock-out" spindle which is removed without disturbing the bearings. The table tilts to 45 degrees, its movement controlled by a hand wheel. The arbor which is raised or lowered according to the depth of cut required, is also regulated by a hand wheel. The guard is a light-weight alloy, unusually efficient. Ripping fence is extremely rugged and its unique design permits cutting several angles without tilting the table.

DISTRIBUTED NATION-WIDE THROUGH THE FOLLOWING RETAIL OUTLETS

Chain Stores: W. T. Grant Co. · S. S. Kresge Co. · Sears, Roebuck & Co. · F. & W. Grand Co. · Neisner Bros. · McLellan Stores · J. J. Newberry Co. · Metropolitan Stores

Mail Order Houses: Sears, Roebuck & Co., Chicago, Ill. · T. Eaton & Co., Ltd., Canada

Also sold at thousands of other retail stores. Buy from dealers—not sold direct.

DRIVER POWER TOOLS

Ⓢ This seal on an advertisement signifies the approval of POPULAR SCIENCE INSTITUTE OF STANDARDS... See page 8

New Ideas *for* Auto Workers

Simple Wiring Scheme That Outwits Thieves

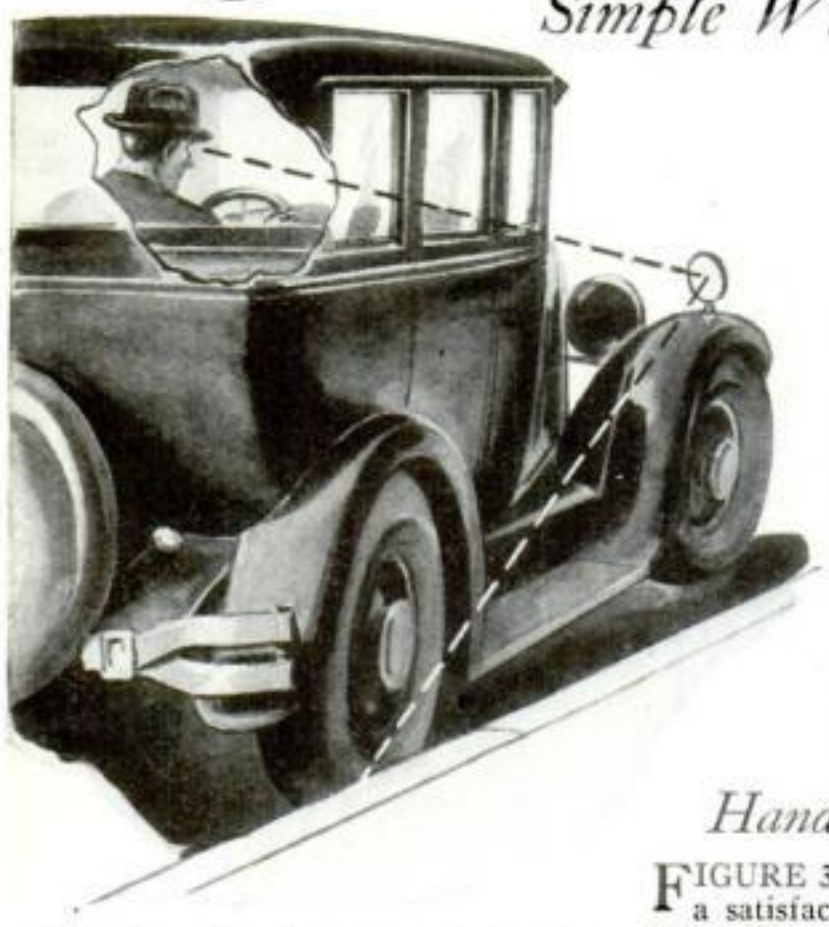


Fig. 1. Rear view mirror set on front right fender will prove helpful in parking the car

MANY motorists have difficulty in telling how far the rear wheel is from the curb when attempting to back into a parking space. A neat way to eliminate this trouble is to fit a rear-vision mirror on the right front mudguard and set it so that it gives the driver a view of the road surface near the right rear wheel. On some cars with exceptionally high hoods and relatively low mudguards, it may be necessary to mount the mirror on an extension rod to make it visible from the driver's position. Testing will tell how long to make the rod.

Dustpan For Garage

MOST owners of home garages have an old five-gallon can on hand. Use this to make the useful dustpan shown in Fig. 2. With a pair of tin shears, cut away the top half diagonally and then fit a wire bale handle. Place the holes for the handle close to the open end so that when you lift on it, the open end will swing up and allow the debris to slide toward the closed end of the container.

Fig. 2. Cutting away the top half of old oil can and fitting on handle makes a dustpan

Handy Watch Holder

FIGURE 3 shows a simple way to make a satisfactory watch holder for use in a car. It permits any standard smooth-backed watch to be held at any desired position on either the dash or the windshield. Remove the rubber vacuum cups from two of the various novelties so fitted and fasten them, back to back, by means of a screw and nut as indicated in the cut-away view. Moisten both cups and press on in the usual manner. The watch can be easily set or wound without removing it from the cups.

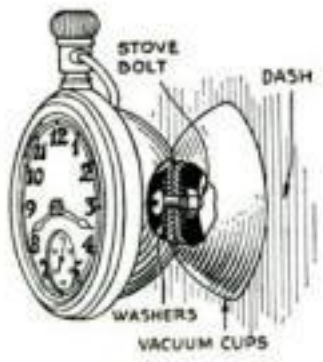


Fig. 3. Vacuum cups hold watch to the dash

Stops Oil Waste

ON SOME cars, especially if the piston rings are not as tight as they might be, the gases escaping from the oil filling pipe carry a certain amount of oil in fine drops. This oil gets all over the engine and also represents a waste. Figure 5, at right, shows a simple type of home baffle arrangement that will serve to catch the droplets of oil and return the waste to the crankcase. It is made from a tin can of suitable size into which have been soldered two or more cheap tin funnels as shown in the illustration.

WIN A $10 PRIZE

Each month we award $10 for the best idea sent in for motorists. This month's prize goes to Fred G. Mehnert, Chicago, Ill. (Fig. 4). Contributions are requested from all automobile mechanics and if published will be paid for at regular space rates.

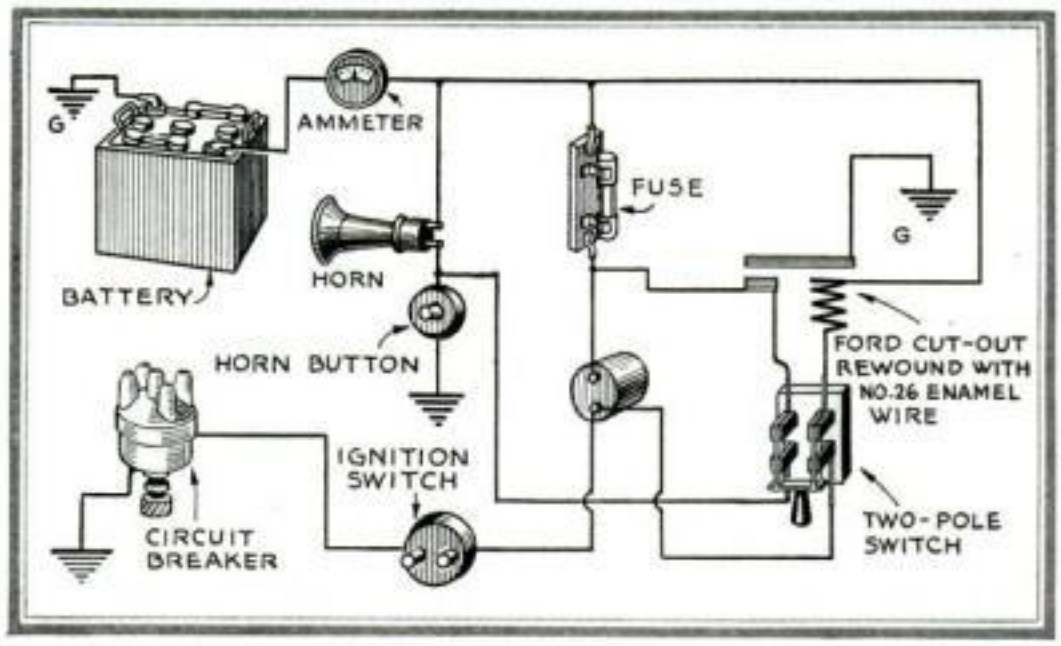


Fig. 4. Diagram shows how to wire car to sound horn and blow fuse if tampered with

Beating the Thief

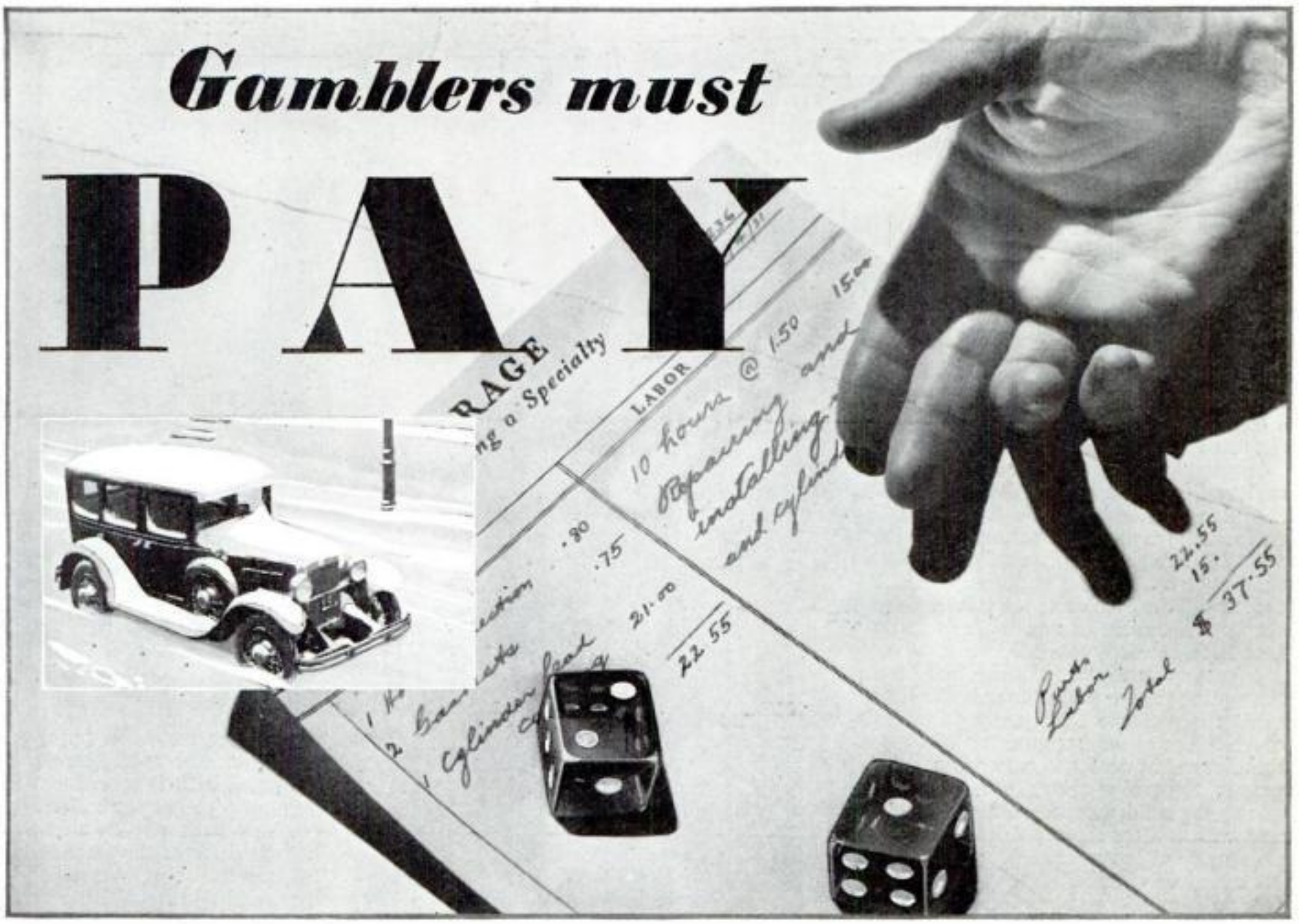
FIGURE 4 shows a way to wire your car that will fool even the expert auto thief. The circuit is quite simple to install, but its electrical operation is most ingenious. When the double-pole, single-throw switch is in the closed position, a thief attempting to start the car will turn on the ignition and step on the starter. As the motor turns over, the circuit breaker will close. This allows current to flow through the cut-out, closing it, and this, in turn, burns out the fuse to cut off the ignition. At the same time the horn will blow until the secret switch is opened. A new fuse repairs the ignition system.

Fig. 5. Tin can with funnels in it makes baffle to catch waste oil

Muffling the Exhaust

WITH modern motors, the snappy valve action causes a loud exhaust. The noise of the exhaust itself is reduced by the muffler, but there are vibrations produced in the steel walls of the muffler and pipe that cause drumming effects in the car interior. A way to reduce these noises by damping the vibrations is shown in Fig. 6. Cover the muffler and pipe with asbestos starting at the motor end and working back toward the rear as far as may be necessary.

Fig. 6. Drumming from exhaust is muffled by covering pipe and muffler with asbestos



THAT car of yours cost you a lot of money. Why gamble this winter with unsafe, unreliable "anti-freeze" mixtures — when you can have complete Eveready Prestone protection for so little?

There's no winter-worry with Eveready Prestone. No wondering whether your "anti-freeze" has boiled away. No danger of your car freezing some blizzardy night when you are many miles from home. Eveready Prestone safeguards you throughout the winter.

Last year Eveready Prestone safeguarded more than a million and a half automobiles. Now it is still further improved. New substances have been added which form a film of protection over the rough metals of the cooling-system. They retard the formation of rust, and keep the whole system unclogged and free-flowing.

Makeshift products are never cheaper. Cost-per-gallon doesn't mean anything, when your "anti-freeze" boils away and needs constant refilling. Or when nearly half of what you buy is water, as it is with some other products. Eveready Prestone is concentrated, so that only a relatively small quantity is needed.

Play safe this winter. Have your cooling-system cleaned, tightened and filled with the proper amount of Eveready Prestone. Then you can smile when cold weather comes and other cars start freezing—and gamblers pay their bills!

NATIONAL CARBON COMPANY, Inc.
General Offices: New York, N. Y.
Unit of Union Carbide UCC *and Carbon Corporation*

9 POINTS OF SUPERIORITY

1. Gives complete protection.
2. Does not boil off.
3. Positively will not damage cooling-system.
4. Will not heat-up a motor.
5. Circulates freely at the lowest operating temperatures.
6. Will not affect paint, varnish or lacquer finishes.
7. Non-inflammable and odorless.
8. Prevents formation of rust in cooling-system.
9. Economical—one filling lasts all winter.

EVEREADY PRESTONE

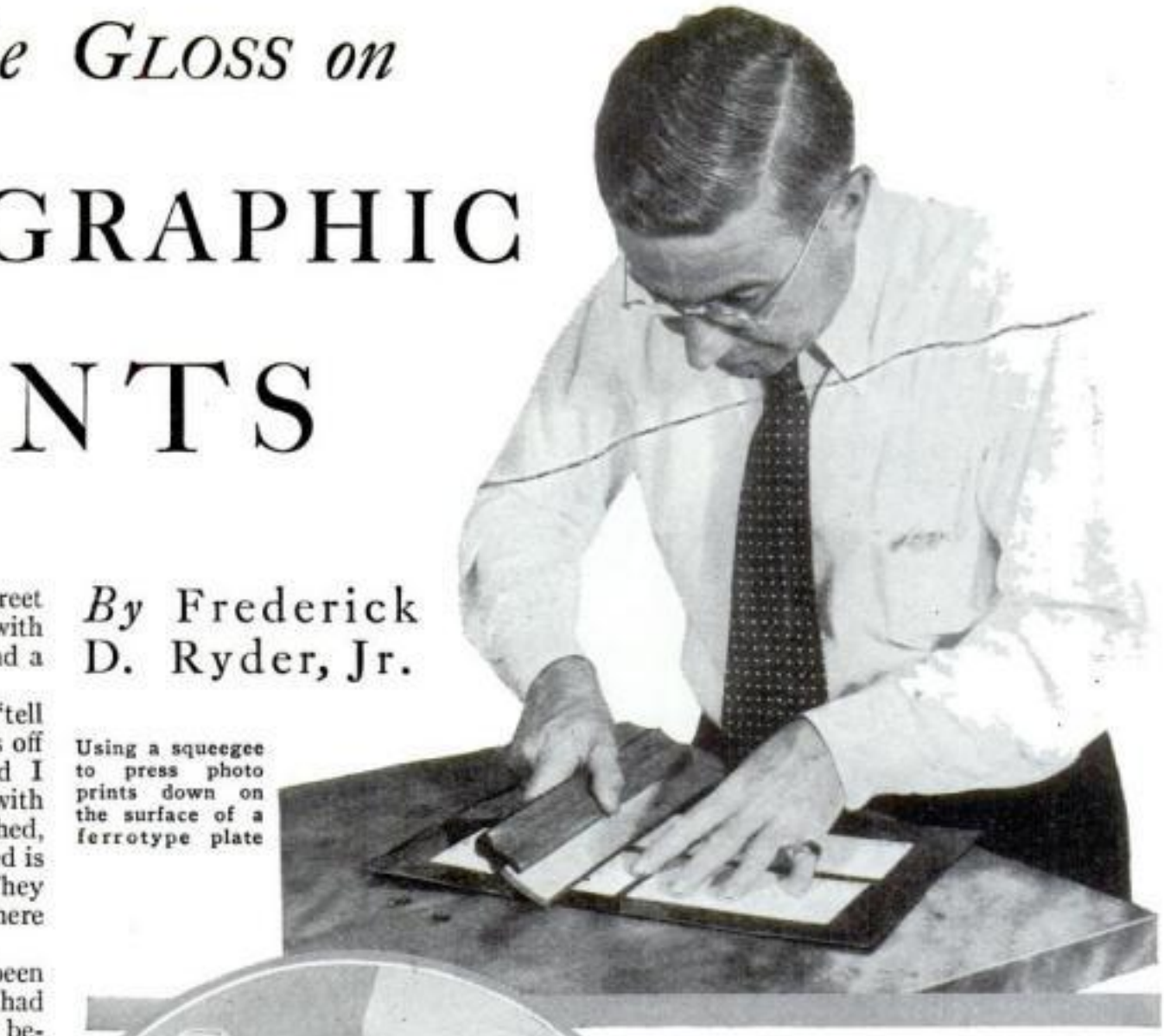
Write for free copy of Eveready Prestone Manual . . . prepared by cooling-system engineers and which contains semi-technical information about this remarkable anti-freeze

NOTE: *When you drain your cooling-system of Eveready Prestone in the spring, put in Eveready* RUSTONE, *for all-summer protection against rust, clogging and overheating. Then your car will* always *be free of rust.*

Putting the GLOSS *on*

PHOTOGRAPHIC PRINTS

By Frederick D. Ryder, Jr.



Using a squeegee to press photo prints down on the surface of a ferrotype plate

A MAN who lives across the street stopped in to see me the other night with a large, flat package under his arm and a disgusted expression on his face.

"Ryder," he grinned sheepishly, "tell me how in blazes I can get these prints off the plates. They're stuck tight—and I don't mean maybe! I've pried at 'em with a pin till I've got the plates all scratched, and as you can see all I've accomplished is to chew up the corners of the prints. They simply won't come off and that's all there is to it. What do I do next?"

It was quite evident that he had been attempting to give the photo prints he had made the glasslike finish so popular because it brings out every detail of the picture. It really is a molding process, the soft wet surface of the print being molded as it dries in contact with a glass-smooth ferrotype plate made of japanned sheet metal.

I examined the shiny black plates (they're called squeegee plates sometimes) with the backs of the small photo prints arranged in neat rows.

"How long have they been drying?" I asked.

"I put 'em on last night," he replied. "That makes twenty-four hours."

"If they're not dry now, they never will be," I said. "Twelve hours should do the trick even in real damp weather. There are two things you can do. One is to kiss the prints good-by and soak them off in boiling hot water. That will save the plates at least. The other is to try baking them off. We may spoil some of the plates and maybe all the prints won't come off even with heat. What do you say?"

"Give 'em the works," he grunted. "It'll give me a lot of satisfaction to see some of those pesky things come loose even if you ruin half the plates."

I LED the way to the kitchen and lighted the gas under the oven. With the door partly open, we roasted those plates, testing them every minute or two, until finally more than half the prints came off in good shape. Some of the others turned brown from the heat before they let go, and a few developed a most unpleasant mottled appearance.

When we had finished, my friend thumbed through the salvaged prints.

"I sure like this glass finish," he observed, "but I wish it weren't so much trouble to get it."

The secret of success in ferrotyping is to have the plates clean and properly waxed

"It's your own fault if you make a hard job of it," I said. "Squeegeeing glossy prints on ferrotype plates to give them a high finish and getting them off the plates again is almost the easiest job in photography if you know how to go about it—and that goes for hot weather, too, when the ferrotyping process is most likely to go wrong."

Having discovered for himself what happens when you don't do it right, my friend proved an attentive listener when I went over the details of the process.

To begin with, I told him, you can't apply the ferrotype process to any photographic paper unless it is labeled "glossy" on the package. Regular developing-out paper sold for making contact prints such as velox or similar types is made in glossy as well as other surfaces. So is the bromide paper used for making enlargements.

The developer you use has nothing to do with the results in ferrotyping your prints or enlargements, but the fixing bath is exceedingly important. A plain hypo bath will not do. You must use an acid fixing bath made from the prepared acid fixing salts or, if you mix plain hypo and add liquid hardener, be sure to add the full amount mentioned in the directions printed on the bottle containing the hardening solution.

The fixing bath also should be reasonably fresh and strong. An old acid fixing bath loses much of its hardening properties and consequently leaves the surfaces on the prints in a softened condition that increases the risk of sticking.

The prints should stay in the fixing bath for at least fifteen minutes, or twenty minutes if the bath has been used for two or three batches of prints.

Wash the prints for at least one half hour in running water. It takes that long for all the salts of the fixing bath to soak out of the paper.

TWO kinds of ferrotype plates are available, the japanned type and the chromium plated type. The japanned ferrotype plates are made from sheet copper, or sheet iron in the cheaper varieties, over which has been flowed a coat of special lacquer. This lacquer is baked on and forms a black coating with a surface virtually as smooth as glass.

If the photographic prints or enlargements have been properly fixed and washed in a fixing solution not over sixty-five degrees Fahrenheit in temperature and the wash water has not been any warmer than this, no special preparation of the ferrotype plates is necessary. They can be washed in warm water and dried with a clean linen cloth, and the prints applied

WHAT IS THE VALUE OF

HUMAN CONTACT?

THE *cost* of telephoning is as little as it can be made. Its *value* can be infinite.

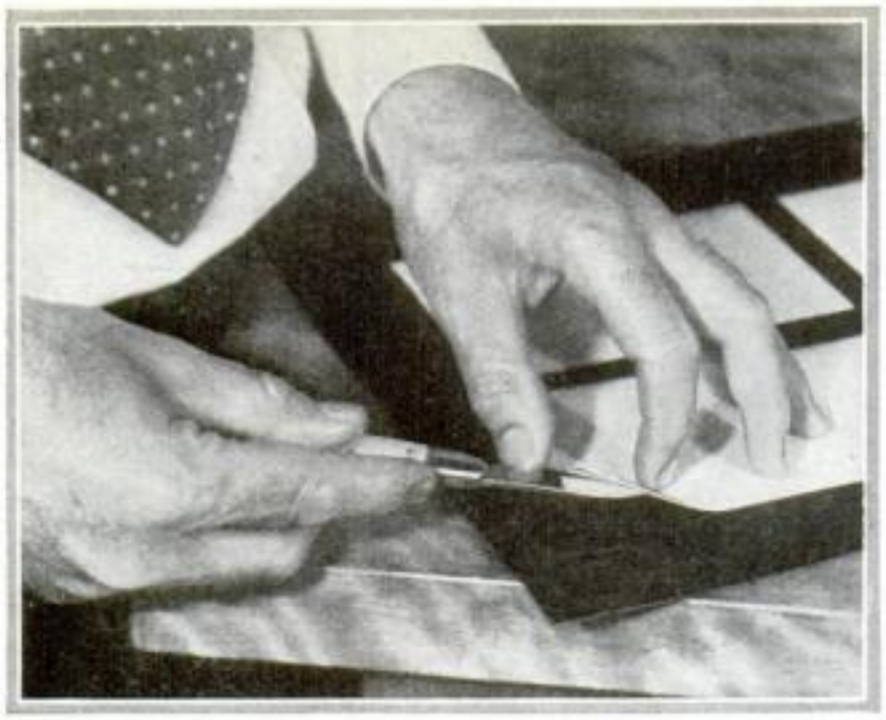
If it is worth your while to save time, to be in touch with people at a distance, to do business quickly, to keep in touch with friends and family—if such things have a value, the telephone holds limitless possibilities for you.

It is the means of extending your personality. Unlike commodities, telephone calls cannot be made wholesale. Each one is a personal service. Each goes when and where you wish. At your request you have five thousand or five million dollars' worth of property at your command, two or three people or perhaps a hundred attending the wires along which your voice travels. It is the work of the Bell System to do this well and cheaply. Its hundreds of thousands of trained workers must keep every part of its 4000 million dollars' worth of equipment ready for instant use.

Here is a business run on the smallest margin of profit consistent with service, security and expansion. Its operation and maintenance have the benefit of the continual research of the 5000 members of Bell Laboratories, the general and technical staff work of the American Telephone and Telegraph Company, and the production economies effected by Western Electric.

Every resource of the Bell System is devoted to making your service clear, quick and inexpensive. As new telephones are added, as improvements are made, you get constantly greater satisfaction and value.

★ *AMERICAN TELEPHONE AND TELEGRAPH COMPANY* ★



If a knife is used to start the prints from the plate, place the blade almost flat so that it will not scratch the surface. As a rule, however, a finger nail is sufficient to lift the corners

with a roller or squeegee. However, I do not recommend this method. The slightest trace of dirt on the plates or even the delay in drying caused by a damp day may cause them to stick.

It is much better to prepare the plates so that there will be no risk of the prints' sticking no matter how slowly they dry or even if the hypo solution is a bit worked out or the water a trifle too warm.

Proper waxing is the secret of sure-fire, never-stick ferrotyping. Assuming that the plates are clean and dry or, in other words, that they have been washed in hot water and carefully wiped dry, simply wipe them with a cloth on which a few drops of the waxing solution have been poured and then polish them with a clean linen or flannel cloth.

The waxing solution is made by dropping a piece of beeswax about the size of a large pea into approximately a pint of dry-cleaning fluid of the benzine type or something similar. Do not use auto gasoline as it may contain end products that will not evaporate. Test the dry cleaning fluid before dropping in the wax by pouring a few drops on a clean ferrotype plate. If it evaporates with practically no trace, it is suitable for your purpose.

NEITHER the quantity of dry cleaning fluid or the size of the lump of beeswax is important. A bit more or less cleaning fluid or wax will make no difference. Allow the solution to stand overnight before using.

As you wipe the surface of the ferrotype plate with the solution, you will note that the cleaning fluid evaporates almost at once, leaving the plate with a foggy appearance. This is caused by the microscopically thin layer of wax. Polishing removes the excess but still leaves enough so that the prints cannot stick.

In putting the prints on the plates, it is necessary to use either a rubber squeegee or a rubber roller to squeeze out the air bubbles that are sure to be caught between the print and the plate. I find the squeegee quicker and more satisfactory than the roller. One pass in each direction is sufficient.

The longer the prints take to dry, the less will be their tendency to curl, but if you are in a hurry, stand the plates in front of an electric fan or put them near enough to a radiator so that they will be gently warmed.

Ordinarily, you can start the prints from the plates after they are thoroughly dry with the aid of your finger nail. If you use a knife, place the blade almost flat against the plate so that the edge will not scratch the delicate surface.

After the prints are off, a careful polishing without using any waxing solution will put the plates in condition for a second batch. Do not attempt to do more than two batches without re-waxing the plates.

A word of warning: Don't try to get the glossy finish by squeegeeing or rolling the prints on a window pane, a mirror, or any other glass surface. Even waxing won't keep them from sticking like a coat of varnish. Use only the regular plates sold for ferrotyping and be sure to keep their highly polished japanned or chromium plated surfaces free of dirt and scratches.

A $10 PRIZE

for the best

Fall Landscape

POPULAR SCIENCE MONTHLY will pay $10 for the most photographically perfect picture of a fall landscape submitted on or before December 1, 1931. The only condition is that it must be taken during the months of October and November, 1931, by an amateur. Any type of camera may be used, and the developing and printing may be done by a professional. Mail both print and negative to the Photographic Editor not later than December 1, and mark your entry "November Photo Contest." If you wish the print and negative returned, send a self-addressed, stamped envelope with entry.

Winner of Second Contest

C. R. Adams, of Bishop, Calif., has been awarded the $10 prize for the best picture in the photographic contest announced in the second article in the series (P. S. M., July '31, p. 83). Those winning honorable mention are as follows: L. Koontz, Deer Lodge, Mont.; Bert Leach, Portsmouth, Ohio; Herbert V. Mitchell, Oakland, Calif.; B. H. Ormson, Burke, Idaho; Dall Quackenbush, Warren, Ohio; Michael Schell, Ellwood City, Pa.; William H. Sebenius, Duluth, Minn.; Paul G. Shippee, Fresno, Calif.; Dwight Spofford, Dayton, Ohio; and J. M. Stofan, Garfield, N. J. The winner of the August contest will be announced next month.

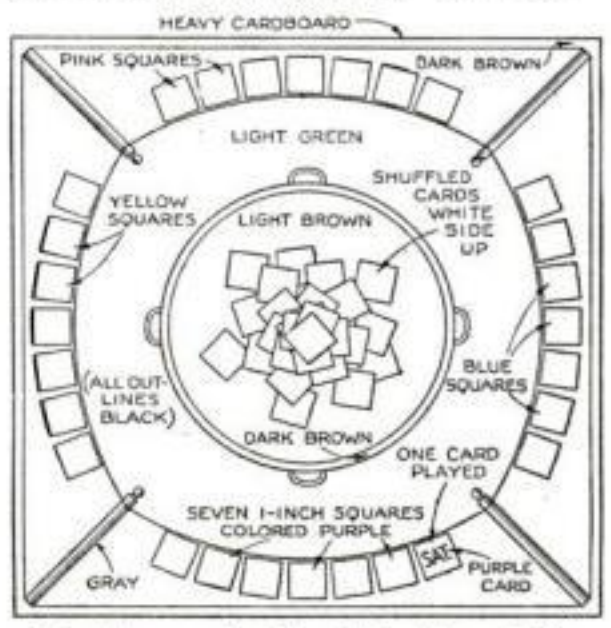
NEW "WASH DAY" GAME AMUSES CHILDREN

THIS "blue Monday" or "wash day" game is both educational and entertaining for young children. It consists of a 16-in. square of heavy cardboard painted as shown and twenty-eight cards 1 in. square. The latter are divided into four groups colored pink, blue, yellow, and purple on one side and lettered with the days of the week on the colored face. The backs of all the squares are left white.

The players choose their colors and take their proper places at the board. All the cards ("handkerchiefs") are placed

You will rarely find a store game that compares with this in giving children enjoyment

white side up in the "basket" and shuffled thoroughly. The first player picks up a "handkerchief" card and looks at the colored side. If the color is the same as his place color, he holds it and puts it on a blank space on the "clothesline" in front of him corresponding to the day of the week printed on the card (see diagram below). When picking up the card, he should not let the other players see the face side. If it happens that the color of the "handkerchief" matches that of the player opposite, he slides it back under the others in the "basket" and is allowed another turn. If, however, it proves to be one of the two remaining colors, he must put the card back in the basket and give the next player a chance. This continues until the "basket" is empty. The first player to hang up a full "line" is the winner. The game gets more interesting toward the end when but two players are left. The loser must put all of the "handkerchiefs" in the basket again, mixing them up for the next game.—D. W. C.



How the game board is laid out. A good size is 16 in. square, but it may be made larger

Here's Real Sport for Father and Son

YOU FATHERS of growing boys—here's real sport that you can both enjoy. And while your boy is having more fun than he ever had in his life before, he is learning that his dad is a regular fellow, and is receiving a training of hand and eye that will help make a real man out of him.

The best rifle team in the world is a boy and his dad with a Daisy Pump Gun, with one of the new steel Daisy Targets, which allows target practice indoors.

On rainy days, in the cellar, garage, or even in the house, what could be better sport than an hour or two of stiff competition between Dad and Junior to see which one has the old eagle eye and the lightning trigger finger.

It's a lucky boy whose father gets him one of these new improved Daisy Pump Guns, and shows him how to use it.

With the above outfit, and a tube of Bulls Eye Steel Shot, a boy has all he needs for daily practice that will train him to be a crack shot.

For over 40 years the Daisy Air Rifle has been the favorite gun of the boys of America. It is a safe gun, and remarkably accurate in its range. The new improved Daisy Pump Gun is the finest boys' gun ever made. Has polished pistol grip walnut stock, and slide action. A 50-shot repeater for only $5.00. Other Daisy models, for every age and purse, $1.00 to $5.00.

Ask your dealer to show you the latest Daisy models, and send today for a free copy of the Daisy Manual. Contains valuable hints on drill and marksmanship.

DAISY MANUFACTURING CO.
Plymouth, Michigan, U. S. A.

For Indoor Shooting

When you get your new Daisy be sure to get one of the new Daisy Targets. Made of fine sheet steel, folds to fit the pocket. Can be quickly set up anywhere. Patented device stops shots from flying wild. Great for rainy-day practice in house, cellar or garage. Extra cards, 100 for 25 cents.

DAISY AIR RIFLES

BULLS EYE STEEL AIR RIFLE SHOT

USE BULLS EYE STEEL SHOT. THE CHEAPEST, TRUEST SHOT FOR ALL AIR RIFLES.

877

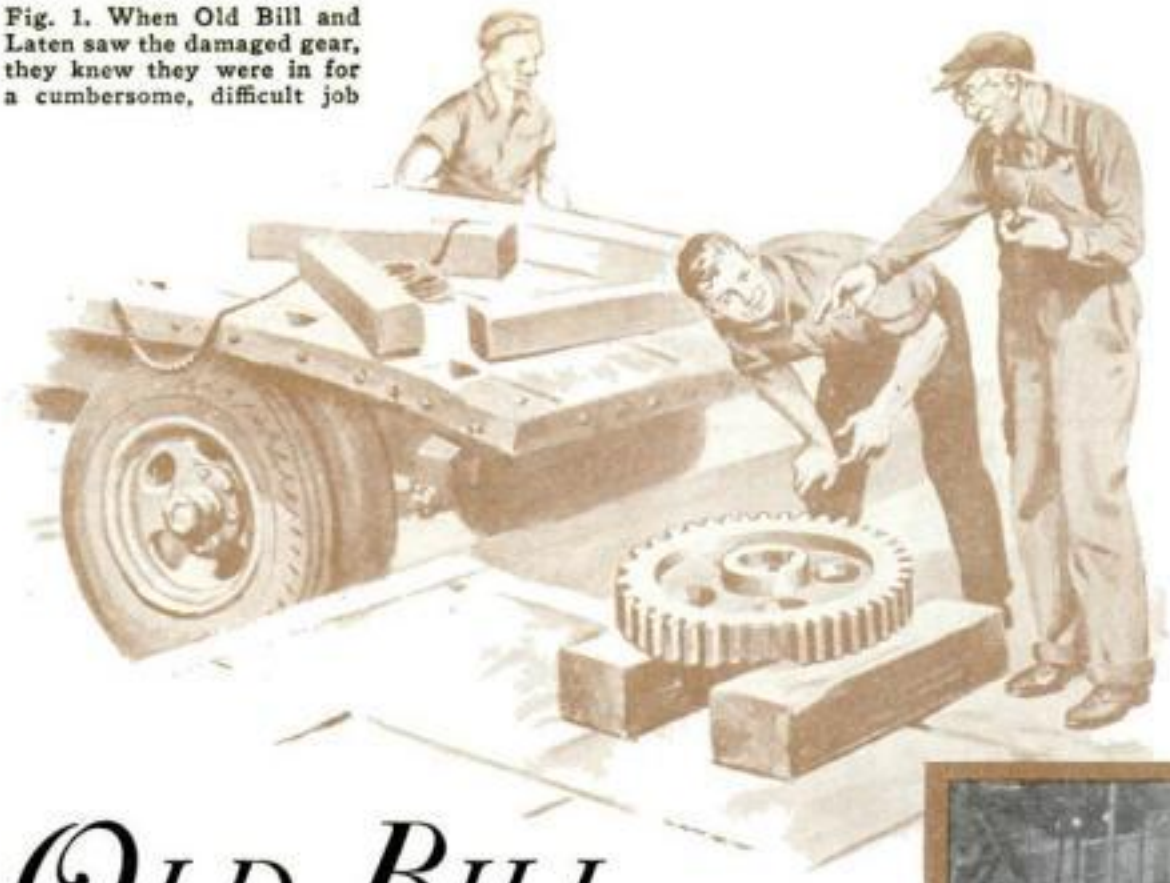


Fig. 1. When Old Bill and Laten saw the damaged gear, they knew they were in for a cumbersome, difficult job

Another Episode from the Experiences of a Veteran Machine Shop Foreman Who Has the Knack of Doing the Impossible in Repair Jobs

By JAMES ELLIS
and
F. J. WILHELM

Old Bill Repairs a Big Gear

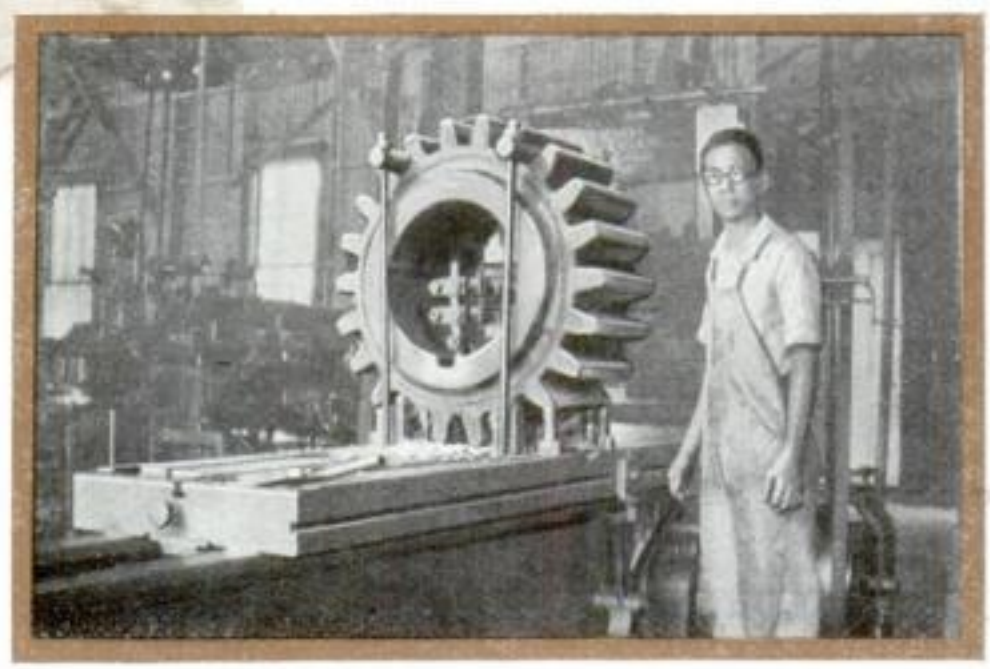


Fig. 2. The photo Old Bill dug out of his files, showing T. Sakamoto, a machinist in Hawaii, using a planer to cut a keyway in a large gear

"WHY so gloomy," Old Bill called out as Bob Laten, his right-hand man, passed through the office on his way to the main floor of the machine shop. "If you're worrying about what the boys are going to do for the rest of the week, forget about it. Something's bound to go wrong at one of the plants around here, and that'll mean work for us."

Bob seated himself in a chair next to the desk and was about to comment on Old Bill's never failing optimism when the jingle of the telephone bell interrupted the conversation.

"It wouldn't surprise me if this is it now," said Old Bill, grinning broadly as he reached for the phone.

From the side of the conversation Bob could hear, he was able to guess that something quite serious had gone wrong at the brick plant in town.

"There you are," Old Bill said as he hung up the receiver. "I told you we'd have some work. A spike or a bolt or something got into one of the rolls down at the brickyard and took four teeth out of one of the large gears. O'Brien, the superintendent, put in a long distance call to the factory to order a new one, but when he found he couldn't get delivery for five days he came to the conclusion it would be better to have us repair the old one. They're sending it right over."

"I'll bet that's going to be a mean job," Laten grunted. "Did he say how large the gear was?"

Old Bill laughed. "Nope," he said. "Old man O'Brien was so excited over the delay the damaged gear is causing that he had a hard time telling me what happened. I gathered that it's about four inches across the face and the teeth have an inch and a half pitch. Speaking of gears, have I ever told you about the repair job I ran across years ago in Hawaii?" Old Bill asked.

Bob shook his head, and Old Bill opened a desk drawer that was evidently a repository for the various bits of scrap paper that, like the rest of us, he kept for no reason other than sentiment. As he pushed the papers from one side to the other, he came across an age-yellowed envelope from which he withdrew a photograph (see Fig. 2).

"That's a memento of the days when I roamed around a bit," Old Bill explained as he handed Bob the photo. "The picture was taken in a machine shop connected with a large plantation. When the gear came into the shop, the order was to recut the keyway, but the pinion was so big that there was no hope of machining it on anything but the planer. A clever young machinist named Sakamoto worked out the scheme of putting an extension tool block on the planer clapper box so that the tool would reach to the end of the keyway That struck me as being a bright idea, so I've always kept this photo. You run across more ingenuity of this kind in out-of-the-way shops than in the big plants—no doubt of it."

"Yes, I realize that," Bob said. "I've seen enough of the stunts you have done around here. I'll bet that's the truck now."

They could hear a truck rumbling up to the shop, so they walked around to the loading platform at the side entrance to see what sort of a job was on their hands. The gear proved to be about 30 in. in diameter and had a heavy rim and coarse teeth. Three of these teeth had been broken out as neatly as if someone had chipped the metal with a hammer.

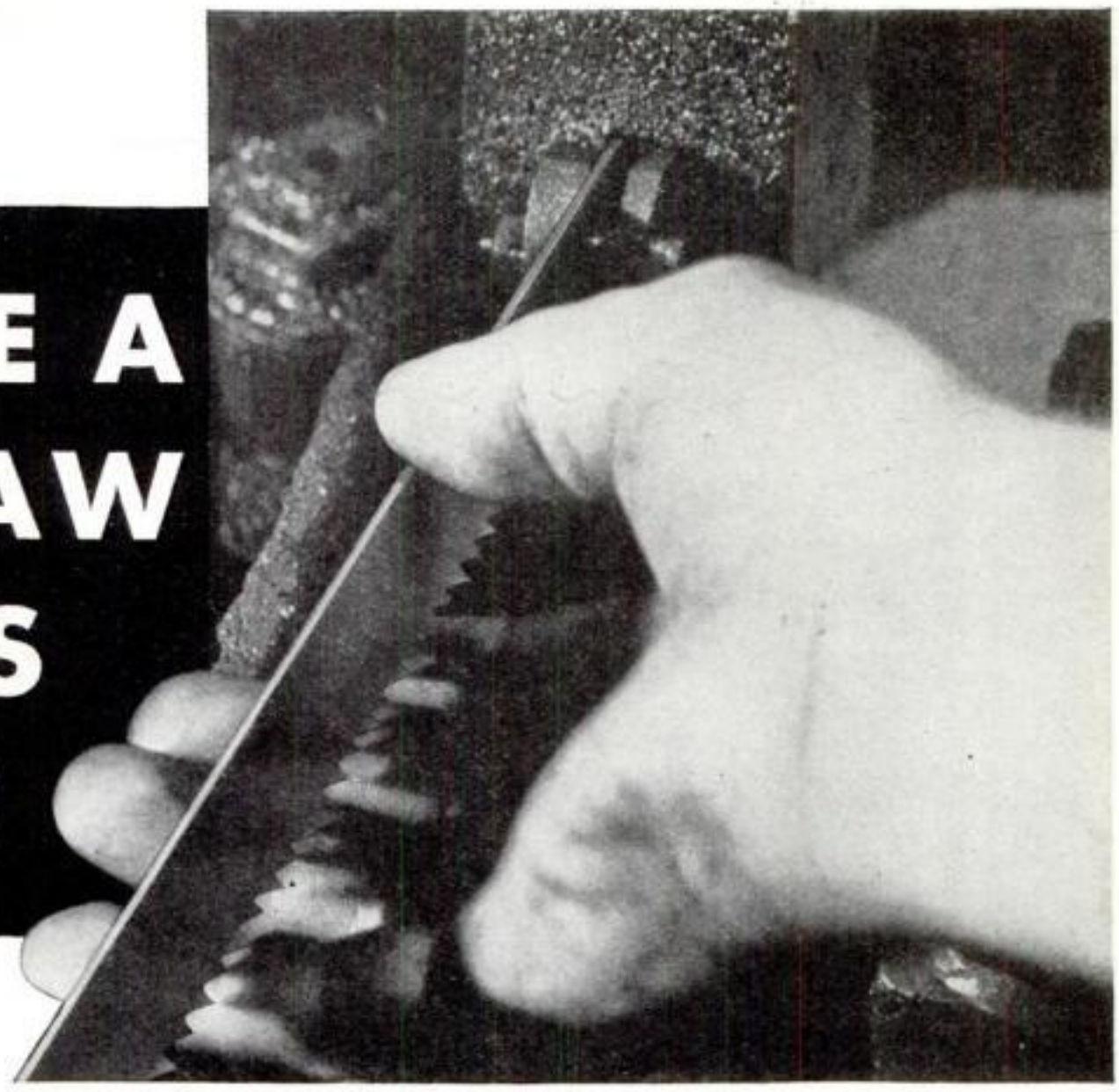
"YOU know, Bob," Old Bill remarked as he inspected the damage, "I believe welded teeth would not stay on this gear. The best thing we can do is to dovetail a piece of steel into the rim and cut new teeth right in the insert."

"We might drill and tap it for stud teeth," Bob suggested.

"Nope," Old Bill replied, "I don't think they'd stand the gaff, either. The insert is our best bet. As far as time goes, I think we can dovetail an insert in there and cut new teeth in less time than it would take to put in stud teeth."

When the gear had been taken into the shop, Old Bill called several of the boys together and began dividing up the work so that, with everyone working at once, the repair could be made quickly. Mak-

JUDGE A HACKSAW BY ITS TEETH



Feel the teeth of a Starrett Hacksaw Blade. You'll find them sound and sharp—still good for plenty of fast, clean cuts — long after the teeth have parted company with an ordinary blade.

It's the steel that does it. The steel . . . and the design . . . *and the heat-treating.* Starrett blades come fairly by their everlasting *toughness* and their everlasting *bite.*

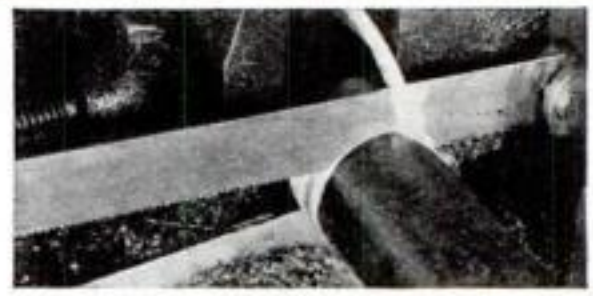
The country's master saw-makers put the value into them. You take it out — in more cuts, faster cuts and *easier* cuts.

There are three different types of Starrett Hacksaw Blades—the High Speed Steel, for extra fast and extra heavy service—the Tungsten, for every-day service — and the Semi-Flex, for blade twisting, chattering cuts in thin metal.

Get the Starrett blades you need from your jobber or hardware store. Try them. Feel their teeth after you've gotten your money's worth out of them— *and keep right on cutting.*

Write for the Starrett Catalog No. 25-W, describing all the Starrett Hacksaw Blades and Frames, and over 2500 Starrett Tools. No charge; glad to send it.

THE L. S. STARRETT CO.
World's Greatest Toolmakers
Manufacturers of Hacksaws Unexcelled
Steel Tapes—Standard for Accuracy
Athol, Mass., U. S. A.



For Machine Shops —use the Starrett High Speed Steel Blades for more cuts, faster and cheaper. They cost more and they're worth *plenty* more.

For Home Workshops —use the Starrett Tungsten Blades for regular jobs and keep an extra Starrett Semi-Flex on hand for the meanest ones. This is Starrett Frame No. 150 — mighty handy.

For Auto Service —nothing in the world like the Starrett Semi-Flex for jobs like this. Vibration or twisting can't hurt it. Sheet metal workers and plumbers like it, too.

For Aircraft Service —use the Starrett High-Speed Blades; they make short work of any kind of tubing. This is the Starrett Frame No. 153 with the pistol grip. *Now send for that Starrett Catalog No. 25-W.*

Use Starrett Hacksaws

5060

ing quick sketches, he indicated to one man what size dovetail he wanted cut in the gear and suggested a means for mounting the large pinion in the shaper (see *A* and *B*, Fig. 3).

To another he assigned the job of making the insert from a block of steel which he had ordered the blacksmith to forge. A third machinist was told to prepare the plunger locating device for indexing as shown at *C*, Fig. 3. Bob Laten went to work grinding the tool for cutting the new teeth.

WITH these jobs under way, Old Bill knew the repair of the gear was just a matter of time, so he went about his other duties, returning every now and then to check up on the work and to direct the bronze welding of the steel insert in place (*D*, Fig. 3).

Intensely worried about the shutdown, O'Brien, the brickyard superintendent, had followed the gear over, so Old Bill explained just what was being done.

"Brazing or bronze welding, as it is sometimes called," he said, "is the best for a job like this. It has two main advantages. For one thing, we don't have to heat the gear to any great extent, so we can't get into trouble along that line. Then the tobin bronze that we use is very elastic, so we don't have to worry about cooling cracks. Another thing," Old Bill continued, "we can make the bronze flow into a thin crack so that in effect we'll have two iron parts glued with bronze."

When the brazing was completed, the gear was mounted in the shaper in the manner shown at *A*, Fig. 3, and a good tooth was located under the roughing tool held in the tool post. The locating plunger was centered in one of the tooth spaces on the side of the gear. Then the plunger was withdrawn, the gear revolved until the tool was above the insert, and the tool fed down the desired amount. In this way both spaces were roughed out.

By this time Bob had completed the finishing tool, which conformed to the original shape of the teeth, and this was inserted in the shaper tool post. After the tool had been carefully located over a space between two good teeth, the gear was revolved the proper amount to bring the tool directly over one of the roughed-out spaces in the insert. When this had been machined, the gear was indexed over one space and the operation repeated.

Old Bill experienced a feeling of satisfaction when the job had been completed. Here, he felt, was a case where the quick delivery of a rush order had again sent the customer on his way with kindly feelings for the organization that could overcome the limitations of their equipment and deliver a difficult repair job on time.

This series of stories relating the experiences of Old Bill, veteran machine shop foreman, began in 1923 and will be continued in future issues. Next month Hector J. Chamberland will offer invaluable suggestions on tool maintenance.

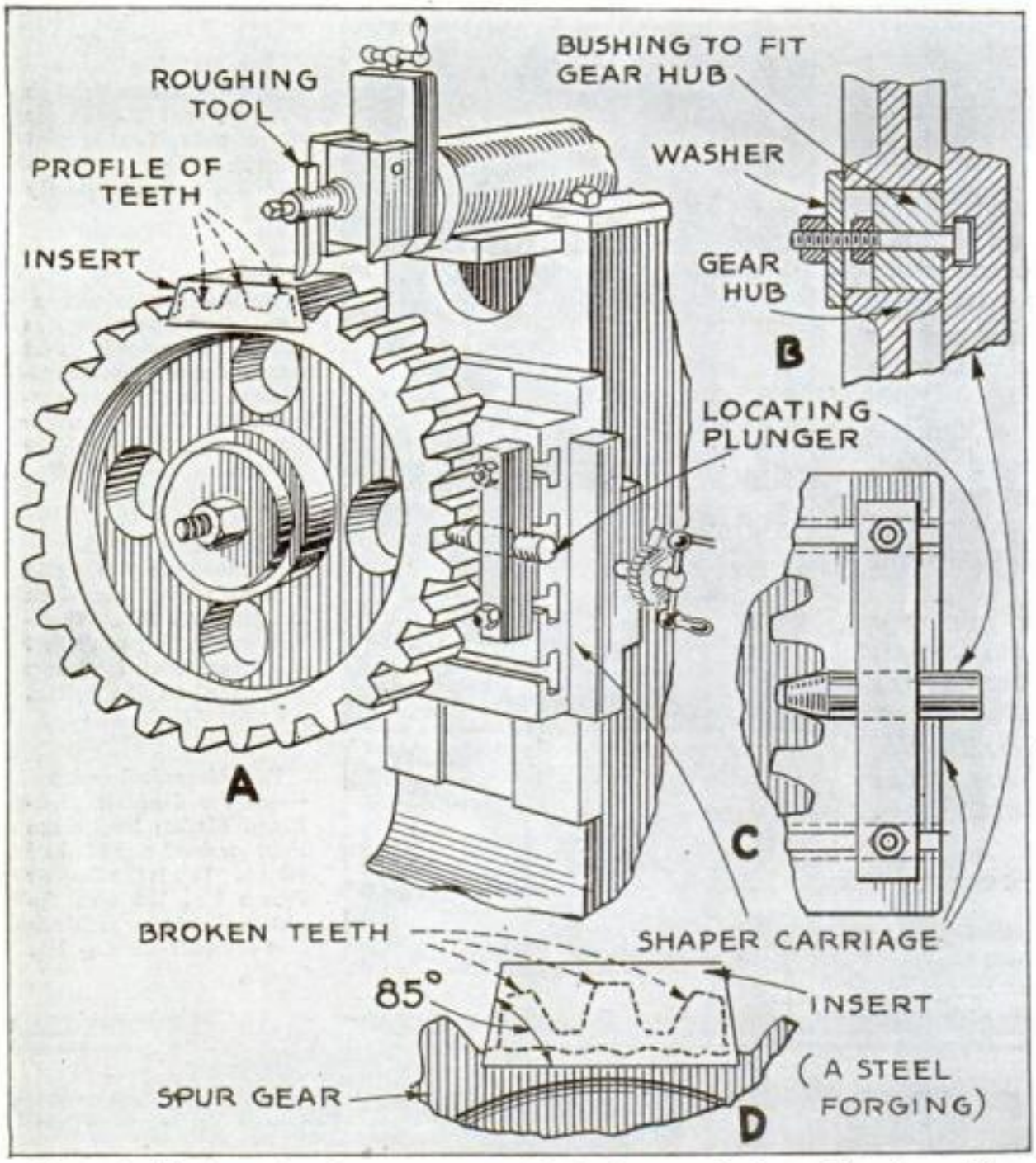
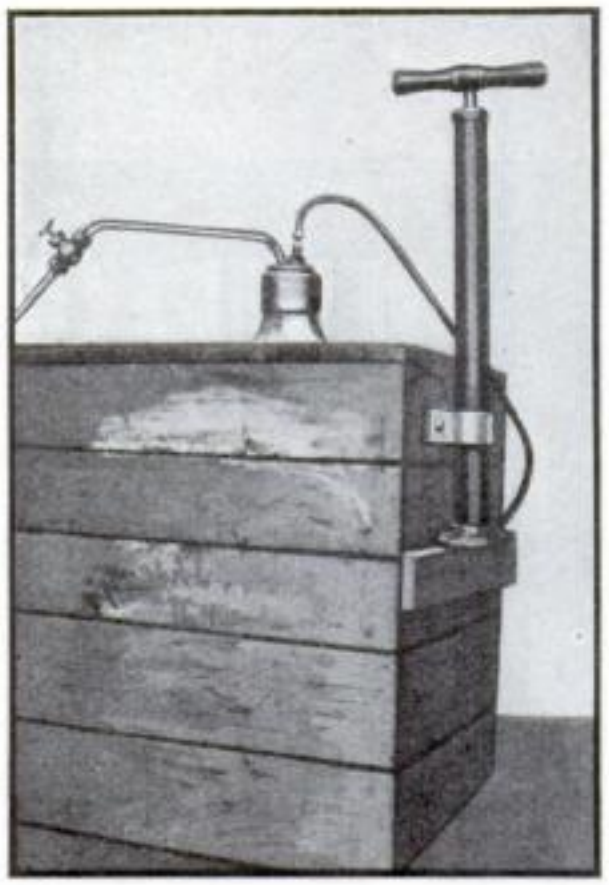


Fig. 3. At *A* is shown how the gear was set up in the shaper ready for roughing the teeth in the dovetailed insert; at *B* is a section through the hub; at *C*, the plunger; at *D*, the insert

CARBOYS EMPTIED WITH AID OF AIR PUMP

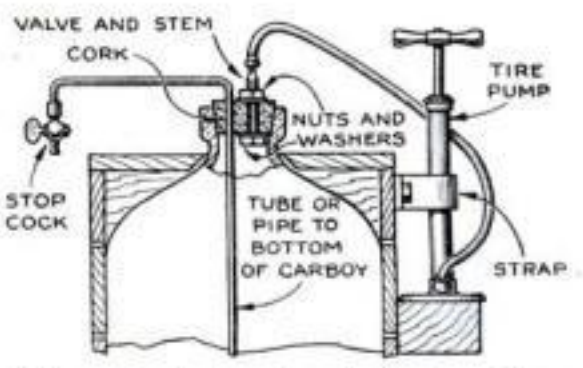


There is no safer way to remove chemicals from a carboy than with air pressure

CHEMICALS can be drawn conveniently and safely from large storage bottles or carboys by the use of an automobile tire pump. Besides the pump and connecting hose, it is necessary to have a cork to fit the carboy, a valve stem and valve with two nuts and washers, a length of ¼-in. pipe or glass tubing (depending on the liquid, as glass is required for acids and hydroxides), and one ¼-in. valve or pet cock.

The pipe or glass tubing is fitted in the cork as shown in the diagram below so as to reach down to within ½ in. of the bottom of the carboy; then the valve stem is fitted in the cork with a nut and washer on each side to make it air-tight. The pump is attached to the side of the case containing the carboy, and the hose is connected to the valve stem.

Air is pumped into the carboy so that when the pet cock or valve is opened, the pressure forces out the liquid without the necessity of tipping the carboy. Casters may be attached to the bottom of the case.—ROGER MEYER.

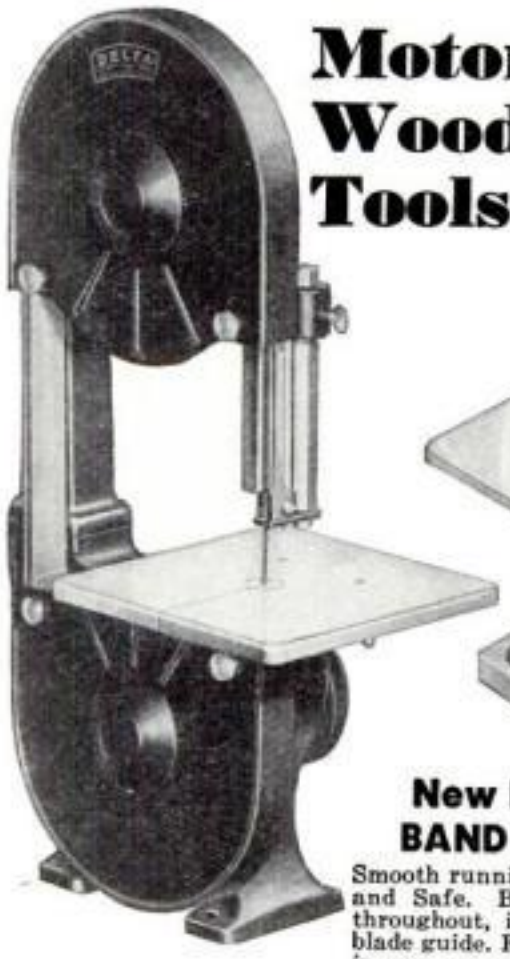


This sectional view through the top of the carboy shows arrangement of the pump

AN ARBOR press of conventional design usually has a plate with four different sizes of slots. It can be made more useful if a number of holes of various sizes are drilled between the slots, for these will take care of much small work that otherwise would have to be blocked up over the larger slots.—J. W. F.

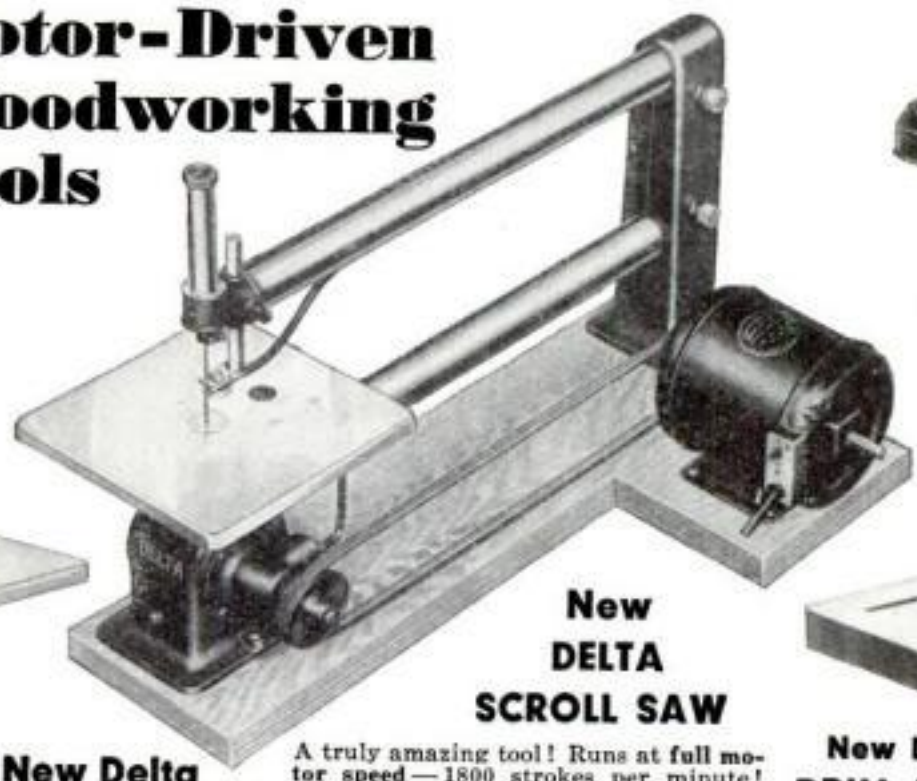
New 1932 "Delta"

Motor-Driven Woodworking Tools



New Delta BAND SAW

Smooth running, Efficient, and Safe. Ball-bearings throughout, including the blade guide. Fully guarded in every way. Graduated tilting table. Surprisingly low priced.



New DELTA SCROLL SAW

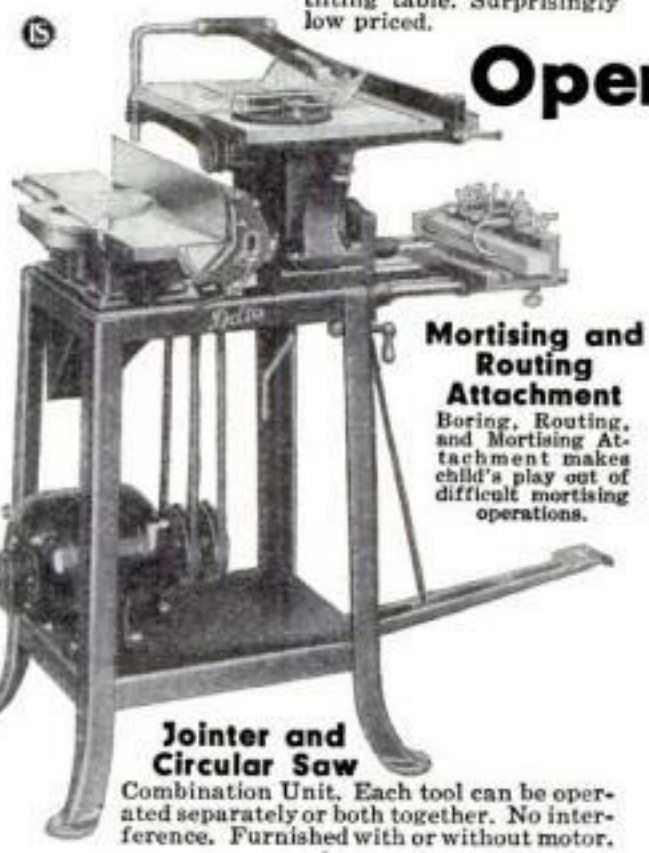
A truly amazing tool! Runs at **full motor speed**—1800 strokes per minute! Extra-smooth operating. Ball bearings. Automatically oiled. 24-inch throat capacity. Rigid frame. Has many unusual features. Numerous uses such as filing, honing, sanding, etc. Sets new standards in scroll-saw performance. Investigate!

New Delta DRILL PRESS

Large capacity. Ball-bearing Spindle. Automatic leveling, accurate tilting table. Many special features — an Unusual Value.

Complete DELTA 1932 Line Includes

- Woodturning Lathes
- Drill Presses
- Complete Handi-Shop
- Jointers
- Circular Saws
- Band Saws
- Mortiser and Router
- Moulding Cutter
- Scroll Saws
- Many New Accessories

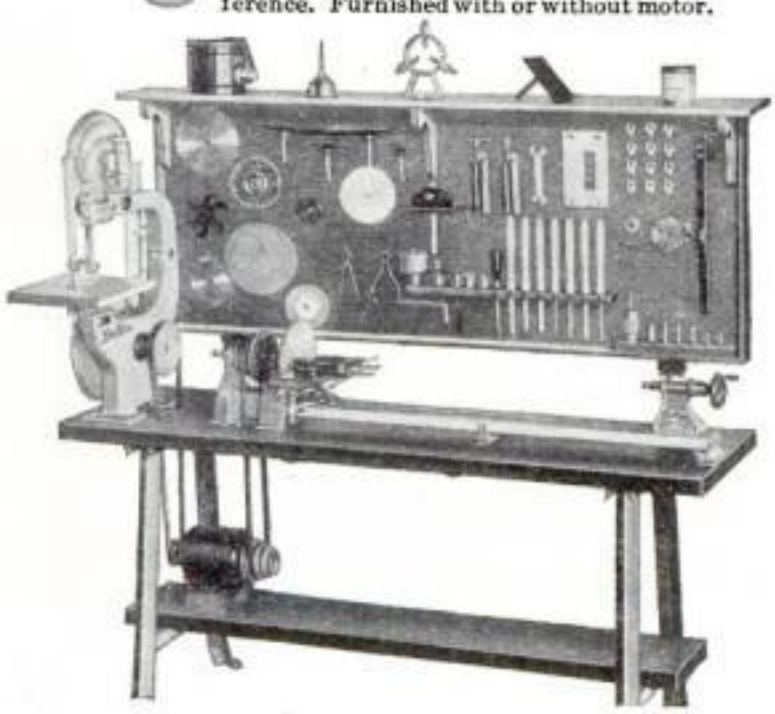


Mortising and Routing Attachment

Boring, Routing, and Mortising Attachment makes child's play out of difficult mortising operations.

Jointer and Circular Saw

Combination Unit. Each tool can be operated separately or both together. No interference. Furnished with or without motor.



Open New Fields to Woodworkers

THIS SEASON Delta announces new "Quality" Motor-Driven Tools of extraordinary interest to those who work with wood for hobby, spare-time earnings, or production work. The entire Delta line has been greatly enlarged and now includes new tools of almost sensational performance finally perfected after years of careful development and testing. ***While new low 1932 prices prevail throughout, the high Delta standards of workmanship, efficient design, and quality materials have been everywhere rigidly maintained.*** Delta still offers the most machine value per dollar. Delta quality still pays in the end! Send coupon at the bottom of this page for FREE catalog giving full details on complete Delta line.

Quickly Pay For Themselves

Delta Quality Motor-Driven Tools save time, money and labor. They take all the drudgery out of woodworking. They enable you to turn out better work in less time. They bring the finest professional cabinet work within the reach of all. Their compactness and practicability, their convenience and low prices, make these motor-driven tools ideal for both production work and home craftsmanship.

Delta equipment is being used today in home workshops, in farm shops, in factories for production work, by contractors and carpenters—in all fields where popular-priced but efficient woodworking tools are needed.

TEN-DAY TRIAL EASY TERMS

Because Delta Tools are **efficient** and practical under actual working conditions, they are always available for a 10-Day Trial without the slightest risk. Satisfaction is guaranteed. For full details of this liberal offer, and also of convenient Easy Payment Plans, send the coupon TODAY!

Send for FREE Catalog

Everything for the modern woodworker—professional, spare-time, or hobbyist—is illustrated and described in this big 1932 Delta Catalog. Send Coupon NOW for your copy.

Complete Delta COMBINATION SHOPS

Here illustrated is the Delta "De Luxe" Combination Shop—a complete woodworking shop that includes 4-speed lathe, band saw, circular saw and jointer—all mounted on bench and convenient, portable Delta stands. Delta Motor-Driven Tools are available in a large variety of combinations and prices to fit all needs.

DELTA SPECIALTY CO.
(Division of Delta Mfg. Co.)
3775 N. Holton St., Dept. B-1131
MILWAUKEE, WISCONSIN

DELTA SPECIALTY COMPANY
(Division of Delta Mfg. Co.)
3775 North Holton Street, Dept. B-1131
Milwaukee, Wisconsin

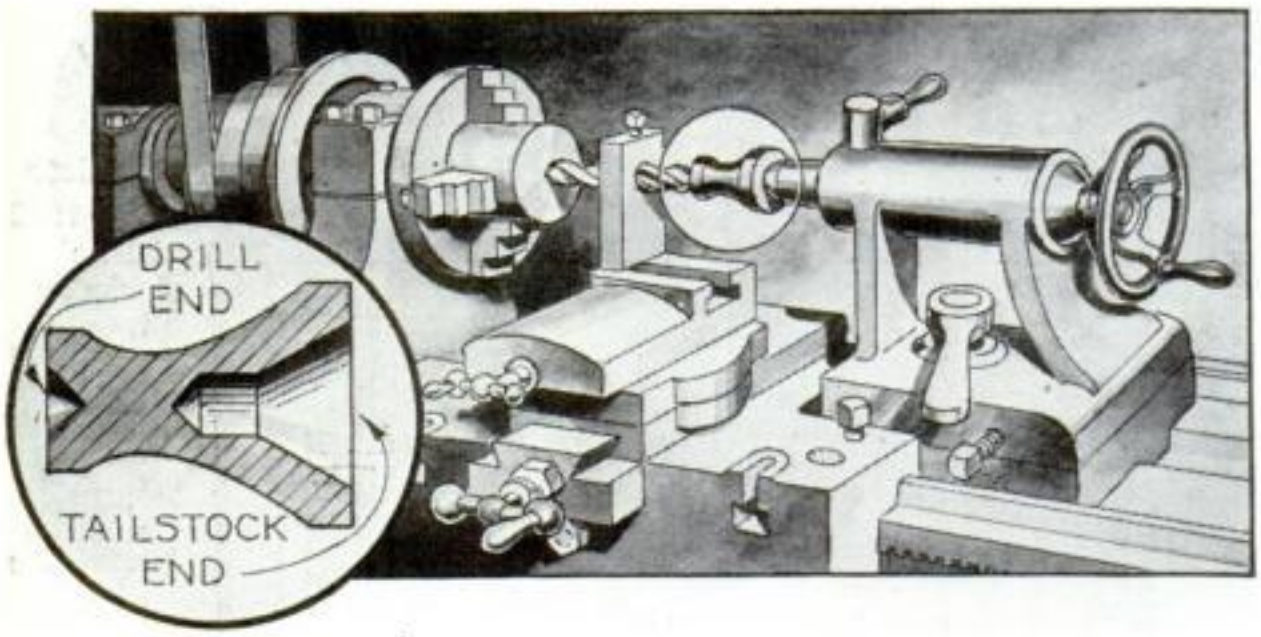
Please send me, without obligation, 1932 Delta Catalog. Also send full details of your 10-Day Trial Offer and Easy Payment Plans.

*Name*_____

*Address*_____

*City*_____ *State*_____

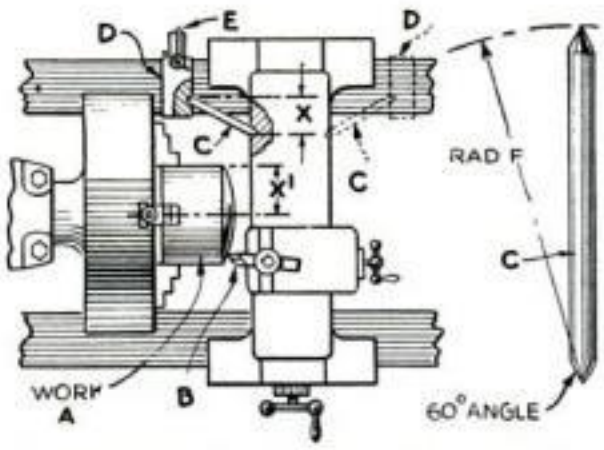
TAILSTOCK CENTER FOR SMALL DRILLS



By doing away with the necessity of using a tailstock chuck in the lathe to hold a small drill that has no center hole, the auxiliary center illustrated above saves the machinist much time. The large end of the center is machined to fit the tailstock, and the small end is shaped to take the end of the drill (see detail above at left). The tailstock end is made as large as possible so that an application of oil will give a sufficient suction effect to hold the center in place. A bar with a hole near one end to receive the drill and a set screw to grip it firmly can be held in the hand or rested against the tool post or the tool-post carriage as illustrated to prevent the drill from turning when the work is revolved. The drill is fed into the work in the usual manner. A complete set of these auxiliary drill centers, covering all the sizes of small drills used, will prove a timesaver.—R. H. Kasper.

TURNING A TRUE RADIUS IN AN ENGINE LATHE

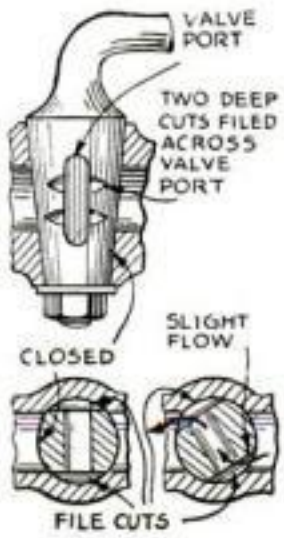
For turning a true radius on forming tools and dies, the writer has found the method illustrated at right to be timesaving and accurate. The tool is shown as if set up for turning a crown radius on the end of a piece of stock *A*. With the tool *B* placed at the beginning of the curve, a block *D* is clamped in a position on the lathe bed that will make the distance *X* equal to X^1 when the rod *C*, which is as long as the required radius *F*, is put in place. Of course, small indentations are made in the block and cross-feed carriage to receive the ends of the rod *C*, which are pointed at a 60° angle. When power is applied to the cross-feed, the rod *C* forces the carriage away from the work, and the combination of the two motions gives the desired arc. By placing the rod *C* and the block *D* on the opposite side of the carriage, it is possible to turn an internal radius.—Clarence J. Turcotte.



Diagrammatic sketch showing how the block *D* and pin *C* are placed to turn a radius.

REGULATING PET COCKS TO GIVE FINE FLOW

By filing two deep nicks across each face of the port opening in the stem of a pet cock used for cutting compound or oil, it is possible to obtain an accurate "vernier" adjustment. Be sure to remove all burrs before reseating the valve. Care must be taken to file the nicks to the right depth.—W. Lyon.



Old Bill *Says . . .*

When boring holes which are to be held to decimal dimensions as to their center-to-center distance, it is best to drill the last hole undersize, insert a temporary plug, and test for the proper span.

A sheet iron gage, indicating the proper rake and clearance, will prove to be a timesaver in grinding lathe and planer tools.

If there is no suitable elastic wheel at hand, a copper disk charged with emery and oil can be used for slotting hardened metal parts.

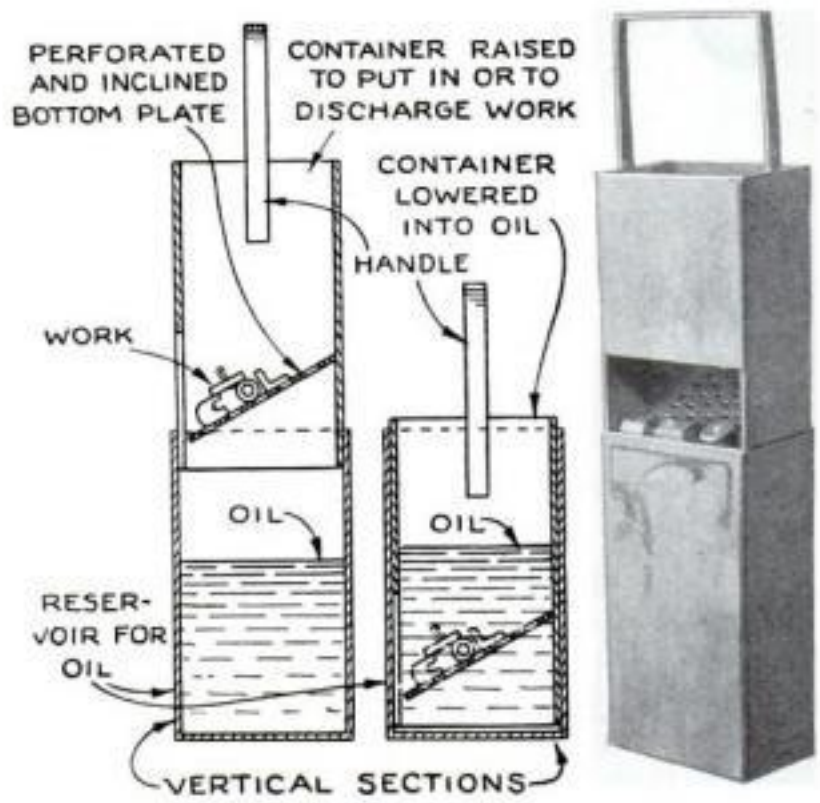
A flat-bottom drill will cut better if a small 60° point is ground on it for a lead. The slight point will serve to eliminate the dead drag at the center of the drill end.

Metal slitting saws without side chip clearance should never be run faster than a milling cutter of the same diameter.

When lapping operations are done in the lathe, be sure to cover the ways so as to protect them from the abrasive action of the lapping compound.

OIL-BATH HOLDER AIDS IN TEMPERING

An excellent oil-bath container for tempering small parts can be made from two square oil cans, one of which is a neat sliding fit in the other. The bottom of the inside can is supplied with holes and replaced at an angle as shown. In use, the tempering oil is placed in the outside container, and the parts are placed in the inside can. By raising the inner container, the parts are lifted out of the oil bath, and the excess oil is allowed to drain off. When the holder is raised to the top, the tempered parts drop out through the opening and fall to the bench or into a cleaning solution, as desired. With an arrangement such as this, the oil covered parts need not be touched.—H. Moore.



The tempering oil-bath container is made from two square oil cans, one of which is a sliding fit in the other.

HOW TO PRESERVE CUT FLOWERS AND OTHER CHEMICAL HINTS

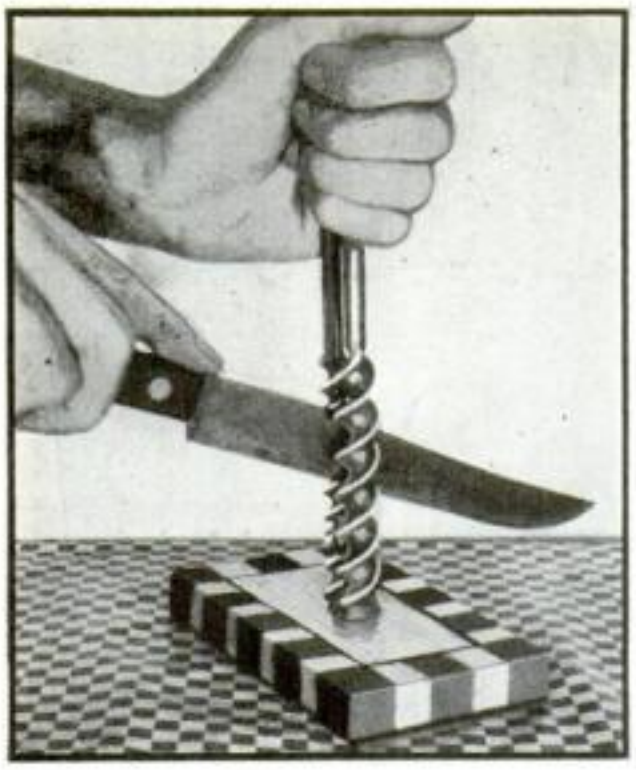
THE best all-around method of preserving cut flowers is to change the water in the vase daily and at the same time cut off a half inch of the stems diagonally. Chemicals also may be added to the water, but each flower requires a different chemical—an interesting field for amateur experimentation. Poppies will keep a few days longer if several drops of gelatine are placed in the center of the flower. Water lilies will not close so quickly if melted paraffin is applied to them in the same way. Lilies of the valley, gardenias, and violets will keep longer if wrapped in paper and placed in the refrigerator overnight. In fact, any cut flower will last longer if kept cool during the night.

Preserving cut flowers offers an interesting study for the home chemist

Vases, bottles, bulbs, test tubes, and other glassware intended for novelty purposes can be frosted with the aid of sodium silicate solution (water glass). At the same time, they may be tinted any desired color by adding water soluble dye to the sodium silicate. Since this viscid liquid, which sticks so firmly to glass, is inexpensive, a sufficient quantity may be used to allow the glassware to be dipped bodily. If desired, just the lower part or one side of the glassware may be treated, depending upon the intended effect. After being dipped, the glass should be immersed in a concentrated and boiling hot solution of epsom salts or of ammonium chloride, preferably the latter.

Iodine stains are easily removed with the aid of photographers' hypo.

An artificial wood for making pressed moldings and imitation carvings can be prepared as follows: Boil together equal parts of hide glue and sawdust with water. Then macerate or steep in water a quantity of newspaper until it is soft, and add sufficient of this to the glue and sawdust to form a soft mass. The glue can be made reasonably waterproof by adding potassium bichromate and exposing the mixture to the light. If desired, a trace of formaldehyde also may be added to the mixture.—H. BADE.

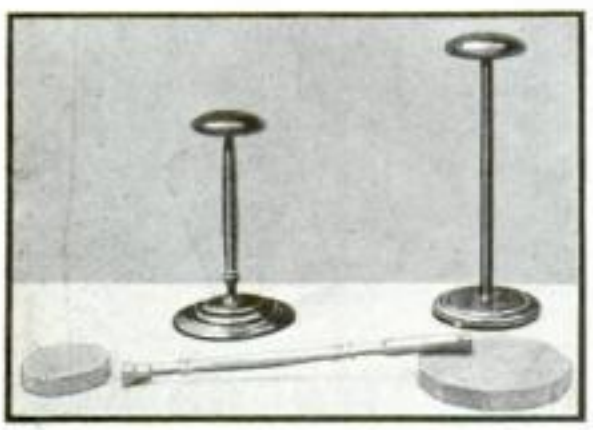


KNIFE SHARPENER MADE FROM TWO OLD BITS

Two wood bits, the screw points of which have been fastened in a block of wood, form a speedy and efficient sharpener for kitchen knives. The shanks or brace-ends of the bits are held firmly in the left hand while the knife is drawn between the augers several times. The sharp steel edges of the twin spirals act as a cutter for the ground edge of the knife. Painting the wood base to match the kitchen decorations will make this odd sharpener more presentable and take away the hastily improvised look it would otherwise have.—RAY J. MARRAN.

HAT STANDS MAKE GOOD TURNING PROJECTS

HERE is a simple project in wood turning that will give the beginner confidence and skill. While primarily intended for practice, however, the work is not wasted, because the finished article may be used as a woman's hat support. Three pieces of wood are needed: a spindle 1 by 1 by 10 or 12 in. long, a base 1 by 8 by 8 in., and a top 1 by 4 by 4 in. Circles are scribed on base and top, and the corners are cut off to make them nearly circular. The beginner may simply round off these pieces on the screw center with a gouge, and then turn the spindle between centers. When the worker becomes more proficient, however, the spindle and base can be turned to a design, although the top should be left plain. The stands may be lacquered in color or given a natural finish, as desired.—H. CALDWELL.

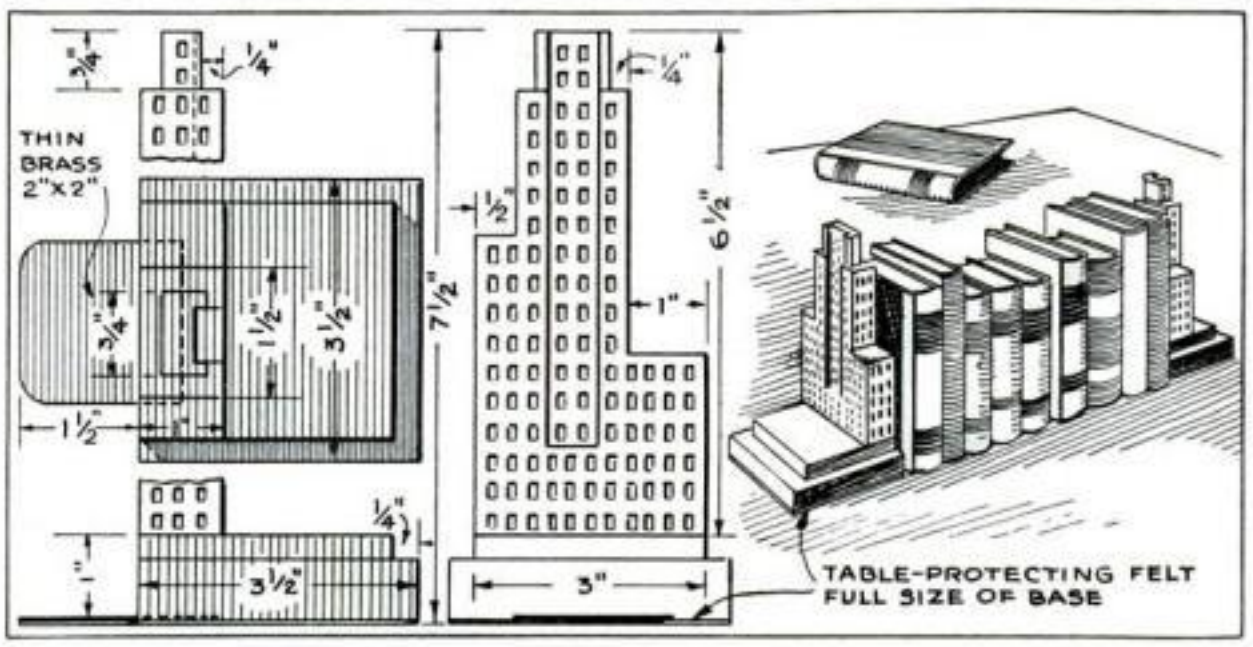


These hat stands form excellent projects for the turner who has had little experience.

SKYSCRAPER BOOK ENDS CUT FROM WOOD

THESE skyscraper book ends add a modernistic touch to the room in which they are used. They may be made of two blocks of any kind of wood 1 by 3 by 6½ in. shaped as shown in the drawings below. They are each attached by means of two long screws to a base block 1 by 3½ by 3½ in., which has a ¼-in. rabbet cut around the upper edge on three sides. Windows are punched in with a spike or any piece of metal filed so that it makes a rectangular mark about ⅛ by ¼ in. Vertical guide lines should be drawn to aid in the punching process. There are no windows on the sides that face the books. Pieces of 2 by 2 in. brass or other sheet metal, which are attached to the bottom as indicated, project out 1½ in. so as to be held down by the first book at each end. The skyscrapers are given a coat of dark stain and sandpapered when dry; this leaves the windows much darker than the walls. Two coats of shellac are then applied and rubbed down, and a coat of wax is put on. The base should be painted a bright color to enhance the modernistic effect. Felt should be glued over the entire bottom to protect the table or desk.—BURL KNUTSON.

BEFORE storing silverware for any length of time, wash and polish it, wrap it in flannel cloth, and place it in a box with camphor. Colored flannel is better than bleached because of the chemicals used in the bleaching process.—H. B.

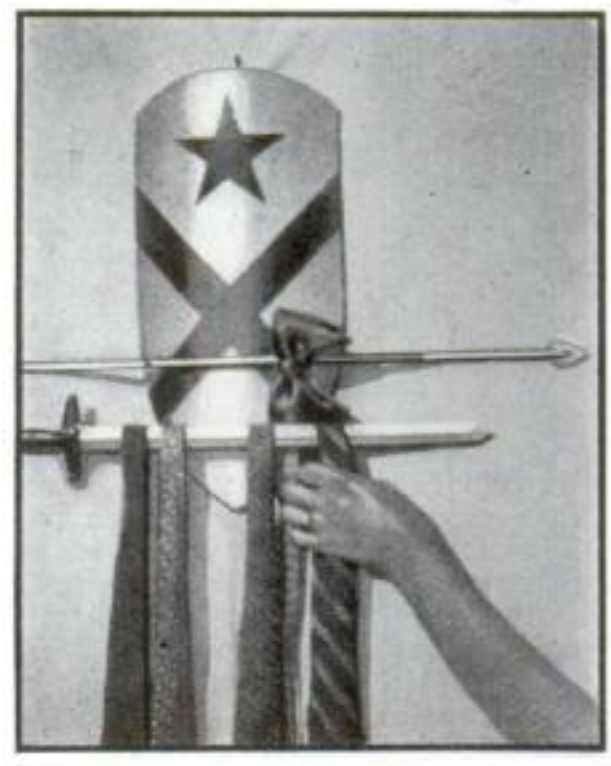


SHIELD AND WEAPONS FORM TIE RACK

THE shield of this tie rack is of heavy cardboard 8 by 16 in. glued to two horizontal wooden formers at the back, which give it a convex shape 1 in. higher at the center than at the edges. The cardboard may be built up of several sheets if necessary, as material thicker than 1/16 in. is likely to crack when bent the required amount. It is also necessary to strengthen the vertical edges by gluing on strips of wood. Thin plywood or sheet metal, of course, may be used instead of cardboard. I gave the shield a coat of varnish on both sides, then painted the front black and silver, and finished it with a coat of varnish. The shield could be painted to represent a particular coat of arms, if desired. The brackets for holding the two crossbars are made of wire.

The javelin or spear is a ¼-in. dowel 24 in. long and slightly tapered toward one end. Points of metal shaped like barbless arrowheads are glued into slots at both ends, the one at the thick end being larger than that at the tapered end. The shaft is finished with silver paint, and a 3 in. wide band of black is painted to represent the grip; this begins 5 in. from the thick end. Then a protective coat of varnish is applied. The javelin is tied to the brackets with fancy cord.

The 18 in. long sword is carved from wood and has a metal crosspiece fastened at the hilt with brads. It is finished in black and silver with a final coat of clear varnish, and then is screwed to the wire brackets.—JAMES A. MCGREW.



A wooden sword and javelin serve to hold the ties on this novel, medieval-looking tie rack.

TAPE AIDS IN DIVIDING A CYLINDER EQUALLY

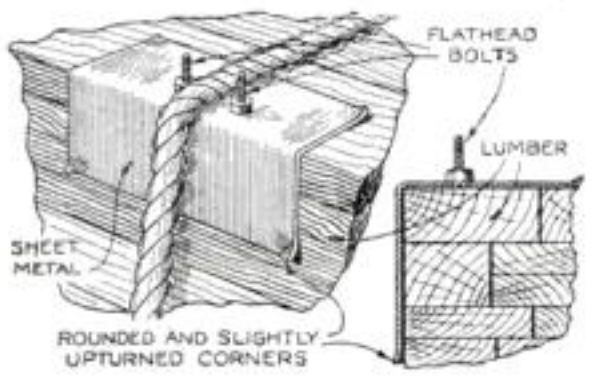
USUALLY an attempt to divide the surface of a cylinder lengthwise into equal parts by ordinary methods is unsatisfactory, but the illustration shows a method by which it may be easily done.

Suppose the rounding surface is to be divided into seven equal parts. Scribe or mark a starting line the length of the cylinder and parallel with its axis. With "O"

The "O" of the steel tape rests on the initial line

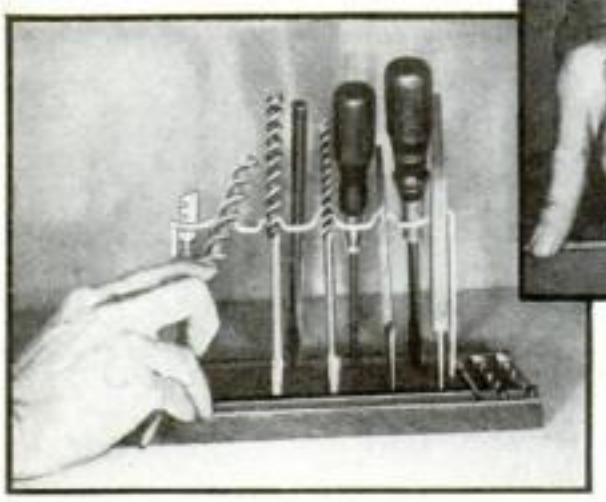
of a steel tape resting on the starting line, wind the tape spirally so that "8" (or some multiple of 8) on the tape coincides with the starting line as shown. Hold the tape with an even tension at all points and do not let it slip. Now have someone else mark the cylinder accurately opposite each of the inch marks on the tape from "2" to "7" (or at whatever intervals are being used). Lines scribed or drawn through these points parallel to the starting line will divide the cylinder into seven equal parts. Any cylinder of any size may be divided into any number of spaces by the same method.—K. C.

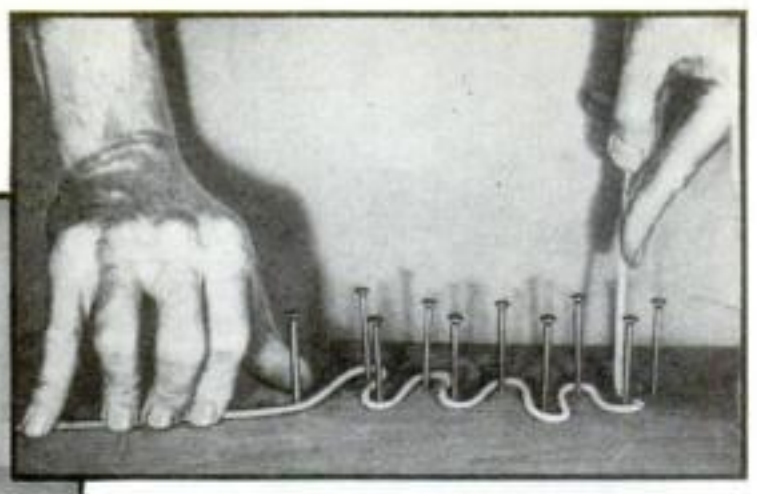
PROTECTING HIGH-GRADE LUMBER ON TRUCKS



WHEN carpenters or lumber dealers have to deliver carefully-milled finishing lumber to a job in a hurry, it is necessary to tie the boards or moldings securely. The tightness of the ropes and the jarring of the truck often mar the sharp, clean-cut edges of at least two otherwise excellent pieces of material. This may be avoided by using the metal guards shown.—N. V. D.

Wire Rack Holds Tools Upright on Workbench





At left: The rack for small tools as it appears on the bench. *Above:* Bending the wire

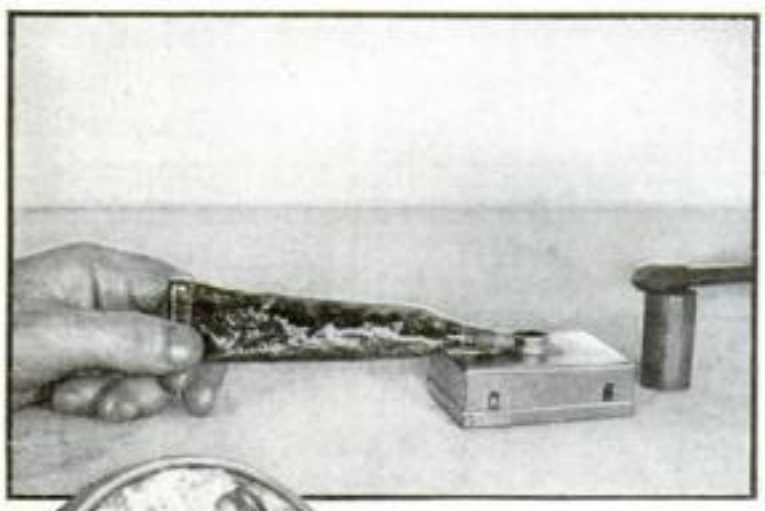
KEEPING small tools in order on the workbench is an easy matter with this bent wire rack. Except for the base block it is made of ordinary No. 10 fencing wire. First draw two lines 1½ in. apart on a heavy block of wood or an old plank and lay off marks at 2-in. intervals to serve as a guide for driving in a number of eight-penny nails as shown in the photograph directly above. At one end of the wire allow 6 in. for what is to be one of the upright legs of the rack; then bring the wire around the first nail and bend the upright part at right angles. Bend the wire around the next nail and continue to zig-zag from nail to nail until sufficient loops have been formed. Allow 6 in. more at the end for the second upright. Prepare a wooden base and drill two holes in it for the uprights, and fasten strips of wood to the longer edges to prevent the tools from slipping off.

EXTENSION LINK MAKES SMALL KEYS HANDIER

Small key lengthened with link from chain

VERY small keys, when carried on a ring with larger ones, are hard to handle. It is difficult to get one of them into the lock and even harder to turn it. All that is necessary, however, to overcome this is to make the key slightly longer so that it is on a par with the other keys. This can be done most easily by using a link taken from a piece of brass safety chain, as shown. Small keys held to the ring in this manner are just as easy to turn in the lock as the larger ones and will be easy to find on a key ring.—F. W. BENTLEY, JR.

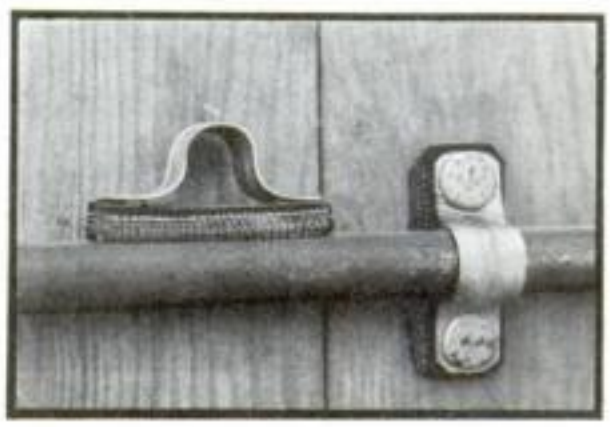
NEW USES FOR WRAPPING TISSUES



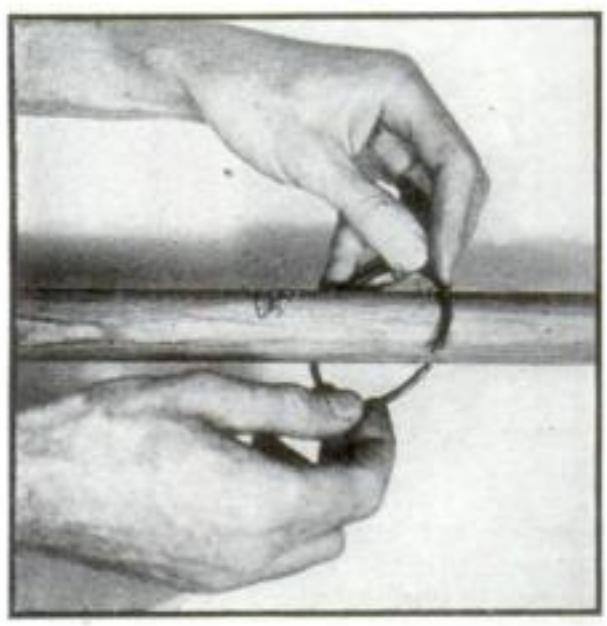
This collapsible tube for soldering paste is made of cellophane and a discarded tire valve

Frame made from an embroidery hoop with the same wrapping tissue as a substitute for glass

TRANSPARENT wrapping tissue of the cellophane type, now used for candy boxes, cigarettes, and many other articles, will be found useful for a number of things besides covering packages. The illustrations show a novel way in which it may be used instead of glass in a nonbreakable picture frame, and also how it will serve for making collapsible tubes for various purposes. The picture frame is merely a ten-cent embroidery hoop of wood, which can be finished as desired. A photograph or magazine illustration, covered by a sheet of cellophane, is placed on the smaller hoop, and the larger one is pressed down over it; or the picture can be cut to a circle of the correct size and mounted on cloth before being clamped in the hoop. The surplus is then trimmed away. By using colored cellophane, unusual effects may be obtained. Frames of this or any other type also are suitable for holding drawings in the home workshop, with cellophane to keep them clean. To make a collapsible tube for soldering paste, gesso, or any special colors or adhesives, roll a sheet of cellophane eight or ten times around a 1-in. diameter paper tube and fasten the inside and outside laps with cellulose household cement. Tie one end of the cellophane tube tightly around a cut-off tire valve from which the inside has been removed (but save the cap, of course). Then fill the tube, and either cement the open end or fasten it with a paper clip. It can be used exactly like a tube of tooth paste, the end being rolled up by degrees. Packages wrapped with cellophane may be tied with a cord made of the same material. The silvery white cord not only harmonizes with the wrapping, but is exceedingly strong. Cut the cellophane into strips 1 or 2 in. wide and fold each of them several times lengthwise; then twist into a hard cord. It will be found far stronger than the best string.—K. M.



Pipes can be held away from a wall or ceiling with spacing pieces cut from an old tire



WOODEN RODS SCRAPED WITH PISTON RING

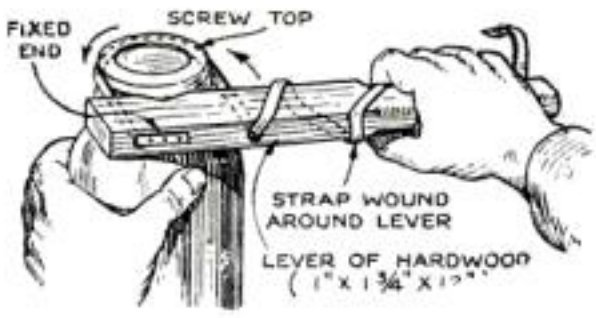
FOR scraping wooden rods, poles, or other round surfaces of small diameter, an old piston ring makes an efficient tool. The sharp edge of the ring, used as shown above, conforms to the surface of the wood and allows a rounding "bite" that is not possible with an ordinary steel cabinet scraper or a broken piece of glass.

PIPE CLAMPS IMPROVED BY RUBBER SPACERS

WHEN small pipes have to be attached to woodwork in a shop or in the basement of a house, it is frequently an advantage to place pieces cut from an old and fairly heavy automobile tire under the sheet metal pipe clamps as illustrated at the left. These extra spacing pieces keep the pipe away from the woodwork, which is desirable for several reasons: the woodwork can be painted with greater neatness; the pipe can be turned or slipped more easily when additional connections or fittings have to be applied; any moisture caused by the sweating of the pipe will not discolor the wall; and the clamps can be torn off more readily and with less damage to the wall or ceiling if the pipes ever have to be removed in order to make necessary additions or repairs.—B. F.

STRAP WRENCH REMOVES STUBBORN JAR CAPS

THE screw covers of canning jars are frequently so hard to turn that some sort of wrench must be used to start them. Such a wrench may be made as shown from a piece of hardwood such as maple or oak, 1 by 1¾ by 12 in. Bore two ⅜-in. holes, shape the handle as suggested, round the corners to save the hands, and make the V-notch. Pass a piece of ½-in. raw-



Hard-to-open canning jar caps yield quickly to this easily constructed adjustable wrench

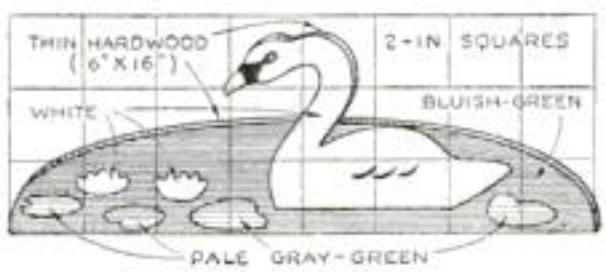
hide 30 in. long or a strap or piece of stout cord through the holes and fasten as shown. In use, place the screw top in the loop, draw the strap tight, and hold it from slipping by grasping it and the handle firmly. Hold the jar so it can not turn and apply enough force to start the cover, after which it may be easily turned off by hand. Always arrange the strap wrench so that the turning of the cap tends to put the tension on the fixed end of the rawhide, strap, or cord.—C. A. K.

COAT HANGER RESEMBLES SWAN ON LILY POND

FROM a piece of thin hardwood 6 by 16 in. you can make a decorative clothes hanger that represents a swan swimming in a lily pond. The neck of the swan forms the curved part to hook over a rod or a clothes hook.

Make a paper pattern on 2-in. squares as shown, cut it out, and mark around it on the wood. Then cut the shape from the wood and smooth it, slightly rounding all the edges.

After giving the entire surface of the hanger a coat of flat paint or of especially prepared enamel undercoater, transfer the entire pattern to the wooden shape with carbon paper. Then enamel or lacquer the swan and the two water lilies white, the four lily pads pale grayish green, and all of the remaining surface of the wood bluish green. If there is not enough contrast between the leaves and the background, paint a white line along the upper edge of each leaf. Use black to paint the eye of the swan, the spot beside its bill, and the three lines which serve to indicate the wing.—HAZEL F. SHOWALTER.



The outline of the hanger can be enlarged to full size by means of the 2-in. squares

How to Get Started in
Model Railroading

By THOMAS W. ARNOLD

If you are interested in model making and are thrilled by the sound of a locomotive clicking its speedy way along the rails, you have all the requisites of a model railroad engineer. In this and two articles to follow, Mr. Arnold tells you about this "ace" of home workshop hobbies

In this well-equipped shop, Edwin P. Alexander of New Rochelle, N. Y., pursues his hobby of model railroad engineering. Mr. Alexander is shown at work on a model of a Pullman car

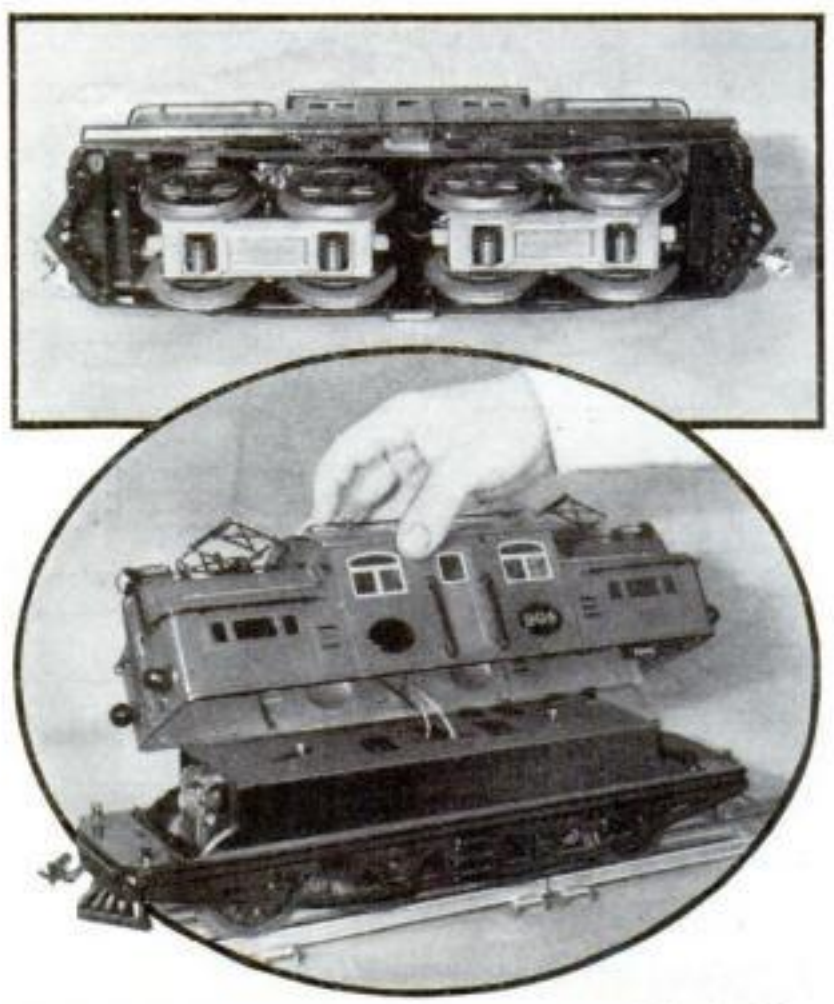
ALL over the world, in cellars, attics, and spare rooms, the members of a great fraternity regularly practice secret and mysterious rites. However, instead of wearing fancy, gold-laced costumes and calling themselves Grand Exalted Rulers, the members of this fraternity have for their insignia fascinating little pieces of machinery and they call themselves model railroad engineers.

To the uninitiated, model railroads mean toy trains, and what are toy trains but playthings for children of tender years? But anyone who digs into the subject soon finds that model railroading has become a serious hobby and occupies the spare time of grown men of all ages. Scattered in all the countries of the globe are gray-haired financiers, doctors, and business men who take a keen interest in building and operating railroads in miniature.

Broadly speaking, the hobby of model railroading consists in taking an active interest in anything connected with the construction or operation of a railroad built on a small scale. The definition is quite broad—necessarily so—since it includes a bewildering multitude of individual interests that may properly be classed as hobbies within hobbies. These range, for example, from constructing miniature scenery and accessories for a tiny railroad with locomotives about twice the size of your thumb to the building and operating of a model railroad so large that it has trackage miles long and actually handles passenger and freight traffic for several small towns in England!

The locomotives on this English super-model railroad are as tall as ponies and they duplicate in miniature, down to the smallest detail, modern full sized locomotives.

Similarly, the elaborateness of a model railroad may vary from a layout costing thousands of dollars to the simple outfit built by the fellow who has to go without lunch whenever he wants to add a few feet to his track.



Views showing construction of the most powerful and elaborate commercial standard-gage electric locomotive available

The hinge pin around which all the model railroad enthusiast's activities revolve is the scale to which he builds his system. If you take a tape and measure the distance between rails on any standard railroad in this or almost any other country, you will find that it is 4 ft. 8½ in. This is the standard railroad gage and is measured between the rails and not to the center of rails. In building any kind of a model, railroad or otherwise, it is standard practice to assume that the foot rule has shrunk to some shorter length so that the foot mark on your shrunken scale may actually be only an inch or less in length. In theory, the reduction in size of all model railroad dimensions should be in proportion to the reduction of the width between the rails. Actual practice, however, does not jibe in all respects with theory in this matter of gage and scale.

The smallest size system recognized by model railroad men is the tiny ⅝-in. gage, which means that the distance between the rails is ⅝ in., and the locomotives and cars are made to a scale of approximately ⅛ in. equals 1 ft. This is called "OO" gage. While this small size naturally appeals to the fellow who wants to cram an elaborate track layout into an exceedingly small space, working to this scale is difficult for anyone who has not had training in watch or clock making.

How gage affects size. The caboose at left is "2½" gage, the one at right is "O" gage. Compare them in size with the book matches

The next size, and by far the most popular among serious-minded model railroad enthusiasts everywhere, is "O" gage. Track in this gage measures 1¼ in. between rails, and the scale used in building equipment is ¼ in. equals 1 ft. Enormous quantities of tin-plated sheet steel track in this gage are turned out each year by manufacturers in this country. This track is catalogued as "O" gage and the dimension is given as 1⅜ in., but it actually measures 1¼ in. between rails.

Above these come gages "1" and "2," measuring 1¾ in. and 2 in. respectively between rails. However, gage "2" is practically obsolete, and gage "1" is rapidly

becoming so. In the United States, "standard" gage has become quite popular. This gage is catalogued at 2¼ in., but it actually measures 2⅛ in. between rails.

Model steam locomotive enthusiasts find the 2½-in. gage track very satisfactory. They commonly build to a scale of ½ in. equals 1 ft.

Several gages larger than 2½ in. are recognized as standard for outdoor model railroads. These range up to about 18 in. between rails.

Although the choice of gage is most important to the prospective model railroad enthusiast, it is difficult to give definite advice. No two men have exactly the same requirements, nor are they interested in exactly the same phases of the subject. Gage "O" is by far the most popular and seems to appeal most strongly to those men who are interested in the subject in general and who therefore wish to build a complete model railroad that will appear as realistic as possible in a comparatively limited space. It is also true that by far the greatest variety of manufactured equipment including track, rolling stock, accessories, and parts are available in this gage.

On the other hand, many men are interested only in some special phase of model railroading, such as electric control, the construction of elaborate scenic effects, or the building of a fine steam-operated locomotive. To such men the track layout and rolling stock are of secondary importance and they are quite likely to purchase commercial equipment in whatever gage happens to suit their fancy. Indeed, there are men who have spent years building model steam locomotives who do not own more than a few feet of track and others who have devoted a vast amount of time to the construction of intricate and elaborate signaling and control systems without having built a single piece of rolling stock.

The question of the choice of gage and scale naturally hinges on how much the model enthusiast is willing and able to spend on his hobby and how much of the stuff he wants to build himself. Also, the question of time is important to many who have but little leisure to devote to hobbies.

Next month Mr. Arnold will continue this instructive series on model railroading as a hobby and will tell you what is available in track for your rolling stock.

HINTS ON GLUING STOCK FOR TURNED WORK

IN GLUING wide stock for faceplate turnings or for large work between centers, the pressure of the hand screws should be applied first at the center rather than at the edges. This allows the air and excess glue to be squeezed out. If this is not done, the joint will not be wood to wood as it should be, but instead will be a weak joint between wood and glue and glue and wood. Aside from the fact that the line of glue resulting from the failure to get a wood-to-wood joint brands such a piece of work as amateurish, the weak joint presents a serious danger when the stock is revolved at a high rate of speed in the lathe.—C. K.

BLUEPRINTS

to Help You in Your Home Workshop

TO ASSIST you in your home workshop, POPULAR SCIENCE MONTHLY offers large blueprints containing working drawings of a number of well-tested projects. These prints are the result of a pioneer effort begun by this magazine in 1922 to provide readers with authoritative drawings at a nominal price. This service has grown to be by far the greatest of its kind. It is conducted solely for your benefit, so do not fail to take advantage of it at every opportunity.

The blueprints are clearly printed on heavy paper 15 by 22 in. In the following list the blueprint numbers are shown in italic type immediately following the descriptive title. In ordering it is necessary to give only these blueprint numbers. Where the title is followed by one number only, the blueprint is on one sheet and can be obtained for 25 cents. Wherever there are two numbers, it means that there are two sheets in the set, and the price is 50 cents. Three numbers indicate that the set consists of three sheets and costs 75 cents. In a few cases, too, there is more than one project on a sheet. A coupon is given below for your convenience in ordering. When using the coupon, be sure to enter the numbers correctly.

Airplane Models

Bremen (3-ft. flying), *89-90*	$ .50
Combination, 20-in-1, *135-136*	.50
Lindbergh's Monoplane (3-ft. Flying), *69*	.25
Rise-off-Ground Tractor, 3-ft., *50*	.25
Seaplane, Tractor, 30-in., *87*	.25
Seaplane, Morris (Record 12½ min.), *102*	.25
Single Stick, Tractor, 30-in., *82*	.25
Tractor (Record Flight 6,024 Ft.), *104*	.25
Twin Pusher, Racing, 35-in., *86*	.25

Boats

Canoe, Sailing Outfit, *25*	.25
Outboard Racer, 11½-ft., *128-129*	.50
Sailboat-Motorboat, Combination (15 ft.), *131-132-133*	.75

Furniture

Bookcase, Modernistic, *88*	.25
Bookcase, Simple, *37*	.25
Book Ends, Modernistic, *100*	.25
Bookshelf, Modernistic, *100*	.25
Bookshelves, Hanging, *77*	.25
Bookstand, Modernistic, *88*	.25
Book Trough, *68*	.25
Broom Cabinet, *49*	.25
Cedar Chest, Mahogany Trimmed, *17*	.25
Chair, Rush-Bottom, *36*	.25
Chest of Drawers, Salem, *39*	.25
Chests, Treasure, *78*	.25
Clock, Grandfather, *19*	.25
Desk, Colonial, *21*	.25
Desk, Flat Top, *20*	.25
Desk, Sheraton Writing, *40*	.25
Dresser, Welsh, *60*	.25
End Table, Magazine, *68*	.25
Kitchen Cabinet, *5*	.25
Kitchen Table Cabinet, *27*	.25
Lamps, Modernistic, *93*	.25
Mirror, Scroll Frame, *105*	.25
Pier Cabinet, *77*	.25
Radio Cabinet, Console, *70-71*	.50
Screens, Modernistic Folding, *91*	.25
Sewing Cabinets, Two, *31*	.25
Sewing Table, *1*	.25
Shelves and Lamp, Modernistic, *93*	.25
Shelves, Corner, *77*	.25
Smoking Cabinet, *2*	.25
Stand, Low Modernistic, *100*	.25
Table, Gate-Leg, *24*	.25
Table, Sheraton, *38*	.25
Table, Tavern, *105*	.25
Table, Tilt-Top, and Bench, *11*	.25
Tea Wagon, *13*	.25
Telephone Table and Stool, *18*	.25

Radio Sets

Amplifier, Three-Stage, Audio-Frequency, *42*	.25
Five-Tube (Battery Operated), *54-55*	.50
Four-Tube (Battery Operated), *43*	.25
Full Electric Headphone Set, *130*	.25
One Tube (Battery Operated), *103*	.25
Screen-Grid Set, *109*	.25
Short-Wave Converter Unit, *137*	.25

Ship and Coach Models

Barque, Scenic Half-Model, *108*	.25
Bottle, Clipper Ship in, *121-122*	.50
Clipper, Baltimore (8-in.), *92*	.25
Clipper—*Sovereign of the Seas*, *51-52-53*	.75
Constitution ("Old Ironsides"), *57-58-59*	.75
Covered Wagon, *118-119-120*	.75
Destroyer—U. S. S. *Preston* (31½-in. Hull) *125-126-127*	.75
Galleon, Spanish Treasure, *46-47*	.50
Mayflower (17½-in. Hull), *83-84-85*	.75
Motorboat, 29-in. Toy, *63-64*	.50
Pirate Galley or Felucca, *44-45*	.50
Roman Galley (19-in.), *138-139*	.50
Santa Maria (18-in. Hull), *74-75-76*	.75
Schooner—*Bluenose*, *110-111-112*	.75
Sedan Chair, Queen's, *123-124*	.50
Stagecoach, Concord, *115-116-117*	.75
Steamboat, Mississippi, *94-95-96*	.75
Viking Ship, *61-62*	.50
Weather Vane, Ship Model, *66*	.25
Yacht, *Sea Scout*, 42-in. Racing, *106-107*	.50
Yacht, 20-in. Racing, *48*	.25

Toys

Airplane Cockpit with Controls, *114*	.25
Birds and Animals, *56*	.25
Broncho, Kiddie, *14*	.25
Circular Saw, *113*	.25
Doll's House, *14*	.25
Doll's House, Colonial, *72*	.25
Doll's House Furniture, *73*	.25
Drill Press, *113*	.25
Dump Truck, *101*	.25
Electric Train, *14*	.25
Garage, *29*	.25
Fire Engine, *101*	.25
Jointer, *113*	.25
Lathe, *113*	.25
Lindbergh's Plane, *67*	.25
Play Table, Pullman, *28*	.25
Sprinkler Truck, *101*	.25
Tea Wagon, *29*	.25
Tractor, *101*	.25
Wheelbarrow, Bunny, *29*	.25

Miscellaneous

Arbor, Gate, and Seats, *9*	.25
Baby's Crib and Play Pen, *26*	.25
Bench Hook, Combination, *30*	.25
Boring Gage, *30*	.25
Garage, One-Car, Pergola, *23*	.25
Log Cabin (Three Rooms), *134*	.25
Puzzles, Six Simple Block, *65*	.25
Swing, Porch, *10*	.25
Tool Cabinet, *30*	.25
Trellises, Garden, *34*	.25
Workbench, *15*	.25

Popular Science Monthly
381 Fourth Avenue, New York

Send me the blueprint, or blueprints, numbered as follows:

No..... No..... No..... No.....
No..... No..... No..... No.....
No..... No..... No..... No.....

I am inclosing.....dollars.....cents in payment (25 cents for each number).

Name .....

Street .....

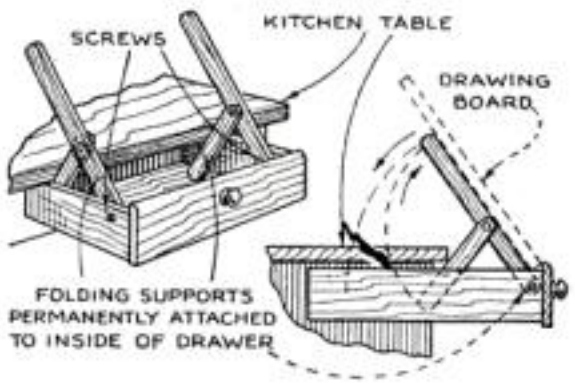
City and State.....

Note: Please print your name and address very clearly. If you do not wish to cut this page, order on a separate sheet.

ADJUSTABLE TABLE RACK FOR DRAWING BOARD

AMATEUR artists or students can easily convert a common kitchen table into an adjustable support for a drawing board. The rack consists of a pair of supports made as shown and permanently attached to the inside of the drawer by means of screws.

When the drawing board is to be used, the drawer of the table is opened and the

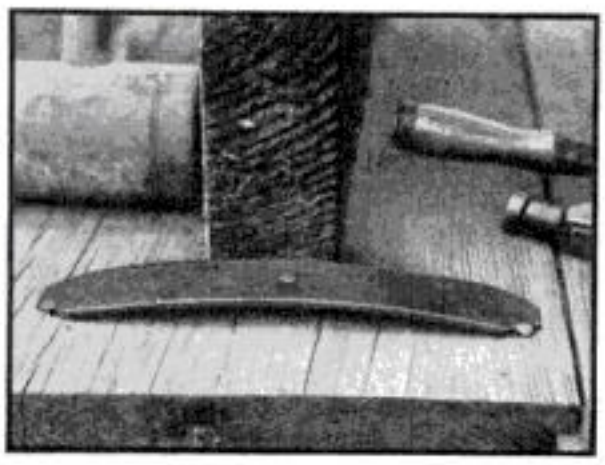


When not in use, this unique drawing board support can be folded and the drawer closed

supports lifted to the desired angle. Then the drawer is pushed in until the shorter pieces rest against the edge of the table top.—G. E. HENDRICKSON.

OLD SPRING LEAF ACTS AS HEAVY WORK STOP

FOR mortising, boring, and shaping heavy timbers and other woodwork too large to be handled on the bench, it is often necessary to fasten a stop of some sort to the shop floor. A scrap piece of lumber will do, but if it is small it is likely to split while being nailed down and if it is large it will be in the way. A better stop, especially if much work is to be done, can be made from a short leaf taken from an old automobile spring. Grind a nick in each of the angularly-shaped ends and use three nails to fasten it down as shown, one nail being driven through the hole in the center of the spring.—F. W. B., JR.



The short leaf can be held rigidly in place with nails placed at the ends and the middle

RAIN spots can be removed from plaster walls and ceilings with a solution made by dissolving unslaked lime in alcohol. Shake the mixture before using and coat the spots thoroughly. When dry, paint or treat the surface in the usual way.—H. B.

CASH PAID *for Shop Hints*

HAS it occurred to you that the labor-saving ideas you have worked out for use in your own shop might help other readers if published, and also bring you in a few extra dollars with which to buy tools, materials, or what you please?

If you have discovered some short cuts in your work . . . if you have made something that other men might like to copy . . . if you have devised some easy methods of keeping your home shipshape . . . if you have developed any ideas that might help a reasonably large proportion of our Home Workshop readers, write out your suggestions and draw some explanatory pencil sketches, no matter how roughly made, or better still, take photographs to serve as illustrations, and mail them all to the Home Workshop Editor, *Popular Science Monthly*, 381 Fourth Avenue, New York.

Whatever you send, I can promise you this—that it will be read carefully and purchased if it can be used to advantage. Articles of from 200 to 500 words are more likely to be accepted than longer articles. When you have an idea for a long article, it is a good plan to send me a preliminary letter describing briefly what you have in mind and inclosing a rough sketch or photograph. I can then tell you at once whether it is worth while to take the time to write it out in full. Should it be unsuitable for any reason, no unnecessary work or time will have been wasted.

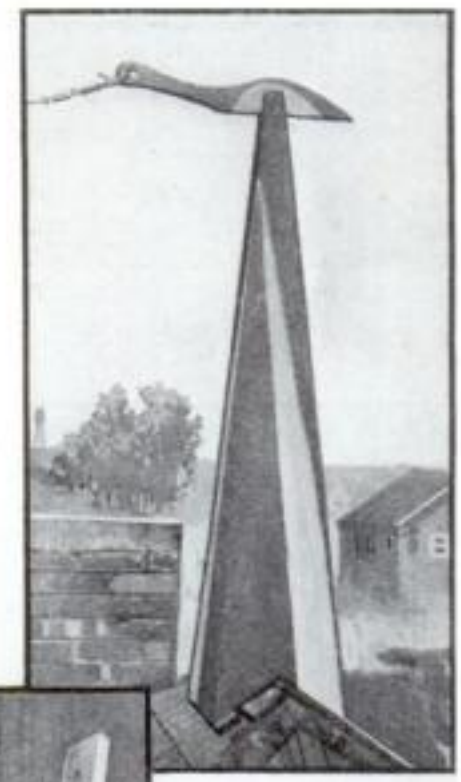
To obtain additional information on preparing articles, send me a self-addressed and stamped envelope. Bear in mind, however, that the ideas themselves are far more important than how they are presented. The way I have always looked upon this department—and the way I hope you will always think of it, too—is as a national clearing house for the ideas of men who make a hobby of their home workshops.

ARTHUR WAKELING
Home Workshop Editor

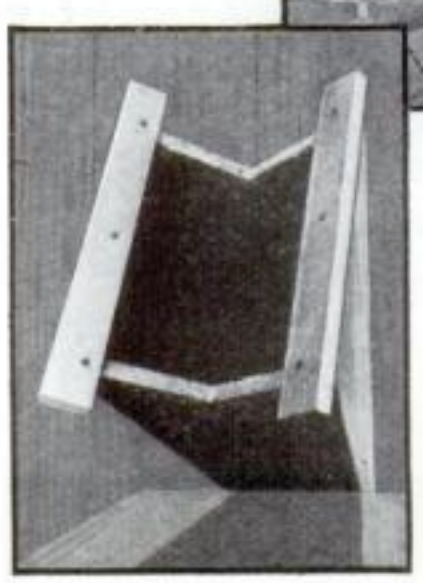
MODERNISTIC ROOF MAST FOR AERIAL

IF YOU wish to erect a high outdoor aerial, you will find it worth while to construct a neat modern-looking roof mast like that illustrated. Because of its broad base, this needs no guy wires. The upright, which is 5 ft. high, is merely a pyramid or tapered box made of ¾ in. thick boards. Two of the pieces are 10½ in. wide at the bottom and taper to ½ in. wide at the top. The other two pieces are 12 in. wide at the bottom and 2 in. wide at the top, and they have V-notches cut in the bottom to fit over the ridge of the roof as shown. A slot 1 in. wide and 2 in. deep is cut in the top of the mast to receive the wooden duck, which is scroll-sawed from 1 in. thick wood. A hole is bored in the head to represent the eyes, and this makes a convenient place to attach the aerial. Two strips are screwed to the bottom of the mast as shown to serve as feet; these project from the sides so that screws can be driven through them and through the shingles or other roofing material into the boards or roof beams underneath. The mast must be very firmly fastened.

This mast was painted green with a modernistic triangular stripe of white on each side. The wooden duck is green with white wings.—B. K.



This roof support for an aerial requires no unsightly guy wires such as disfigures many suburban houses

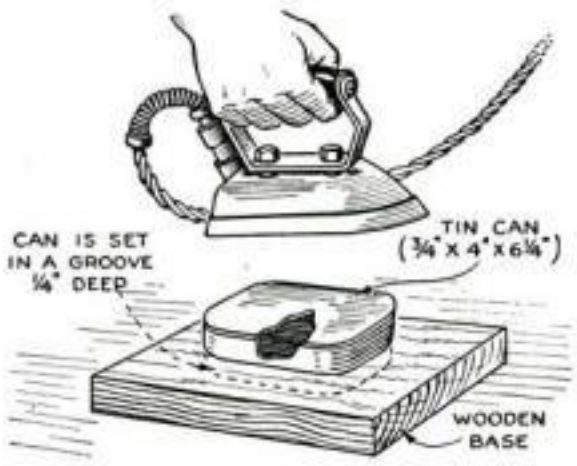


The larger end of the boxlike mast, which is square in cross section. The strips allow it to be fastened to the roof with screws

WHEN painting furniture it is not always convenient to turn the piece to obtain good light on all sides. This difficulty may be overcome by holding a small mirror in such a way as to reflect the light on the shadowed portions of the piece when they are being worked on.—DOUGLAS LEECHMAN.

OVAL CAN FORMS STAND FOR TRAVELING IRON

ELECTRIC irons of the so-called traveling size often have no stands on which to place them while hot. A neat looking stand for this purpose may be made as shown by mounting an empty oval sardine or kippered herring can on a square wooden block. A groove ¼ in. deep should be cut in the board so that the can will be a driving fit. Then the top of the can may be smoothed with emery cloth and the edges and base block painted with green or blue enamel.—HENRY JERVEY.



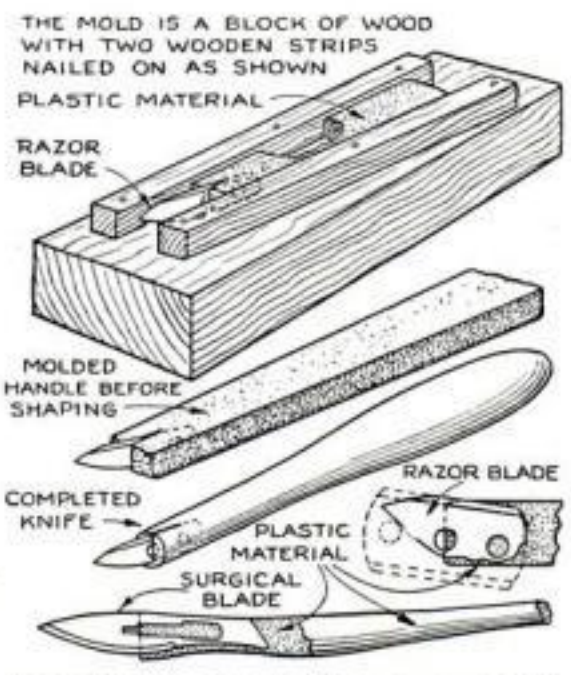
Sketch showing how the tin can is used with a wood block as a rest for an electric iron

SETTING OLD BLADES IN COMPOSITION HANDLES

STRONG, comfortable handles for discarded blades can be made from any high-grade wood composition sold in paste form. Safety razor blades, either whole or broken into convenient shapes, or surgical blades can be fitted with such handles and used in model making and all kinds of delicate handicraft.

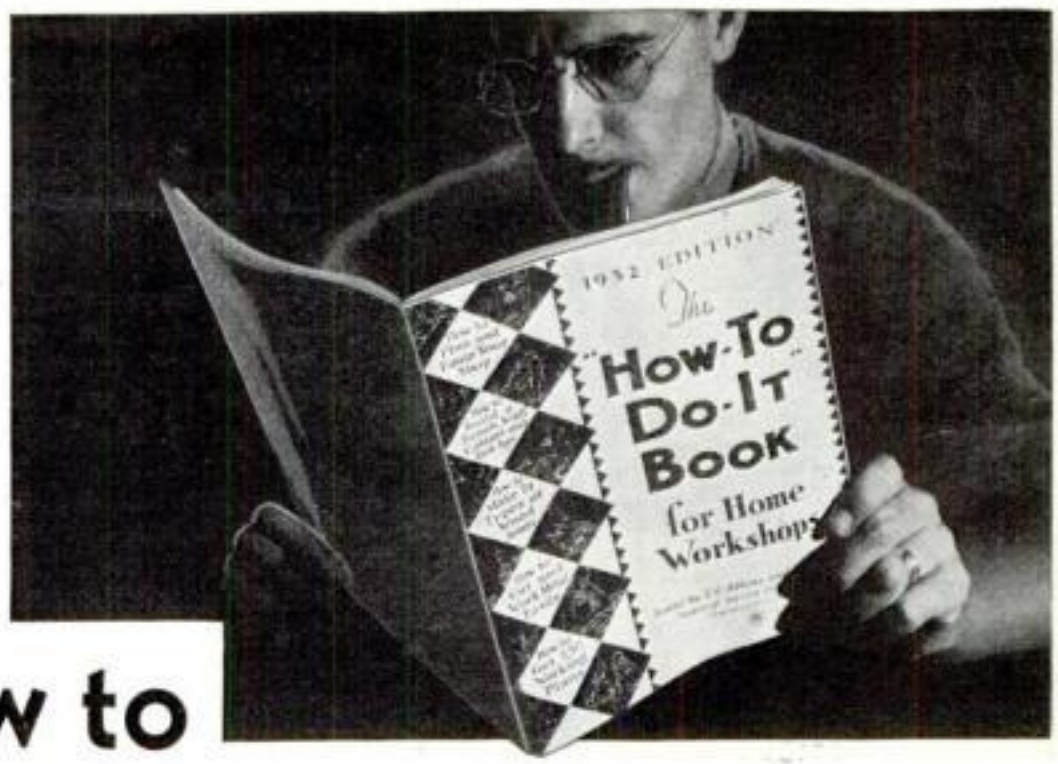
A mold is prepared from a smooth block of wood to which two strips are nailed. After the surfaces of the mold have been coated with hot vaseline, the blade is held in place with a pinch of the plastic material, and the space between the strips is packed full. Allow thirty-six hours for the wood composition to harden; then remove it and shape the handle with sandpaper.

Razor blades set at an angle in blocks in this manner can be used for cutting string.—C. E. LIBBY.



Razor blades or surgical knives mounted in this way form excellent model making tools

Turn to Pages 2-5 of this New Book and See



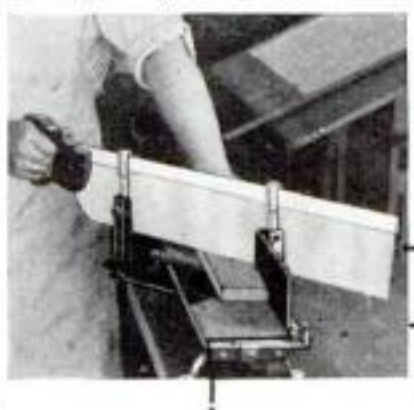
How to Plan a Workshop
—and Equip It, in Three Easy Stages

ATKINS

SILVER

STEEL

SAWS



YOU'LL get a great thrill in fitting up your new home workshop—or modernizing an old one—with the aid of this new ATKINS How-To-Do-It Book, 1932 edition. A veteran craftsman shows you floor plans of an ideal shop and tells you how to equip it, in three easy stages.

First, he shows the best location for your shop, how much space is needed, how to get good light and air, and where to put electrical outlets. Then, he arranges the work-bench, tool racks, supply shelves, saw horses, etc., so as to make a handy shop for the beginner.

In the second plan, he adds new and larger fixtures to equip the shop for a more experienced craftsman. And in the final stage, he shows the shop completely fitted up with modern equipment for cutting and working wood or metal, by hand and machine. It is a shop any man would be proud to own.

But, shop planning is only one of a dozen important subjects treated in this new book. Here is a wealth of practical instruction on HOW to choose your new tools and machines . . . select woods for various shop uses . . . make 24 types of wood joints . . . build your own bench, work-table, tool box, wall cabinet, saw-horse and mitre box . . . cut metals easier, in doing decorative work . . . use grinding wheels and files . . . where to get job plans to make over 450 shop projects . . . and so on.

The final chapter shows you 50 leading saws and cutting tools for home shops—all made of the world-famous ATKINS "Silver Steel" to cut faster, run easier, stay sharp longer, and far outlast ordinary saws.

This book gives you 40 pages brimful of time-and-money-saving information, for only 10 cents. Mighty helpful to every tool user—amateur or expert! Send for it today!

If your dealer does not have the ATKINS Saws you want, write us and we will see that you are supplied promptly.

CUT OUT AND MAIL COUPON

E. C. ATKINS AND COMPANY (Est. 1857)
428 S. Illinois Street, Indianapolis, Ind.

I enclose 10c for the ATKINS Home Workshop Book, 1932 Edition.

Name.....
PRINT
Street.....
City.....State.....
My dealer is.....

Plans by DONALD W. CLARK *for a*

Simplified Monoplane Model

THOSE boys who are fortunate enough to live near an airport where they can watch the planes come and go at close range would have no hesitation in identifying this six-passenger ship as a Stinson-Detroiter, even if its name were not given. Since it is a monoplane of clean-cut design, it is easier to build than any model published in this series in the past six months.

Cut the fuselage and the wing from white pine, and make the rudder, stabilizer, struts, and propeller from sheet aluminum or any thin sheet metal. In the detail drawings the struts have been given identifying letters so that their position in the front view assembly drawing can be seen at a glance. Make the dummy motor cylinders in the usual way by inserting 5/16 in. long pieces cut from 3/16 in. diameter bolts into the nose of the fuselage as shown.

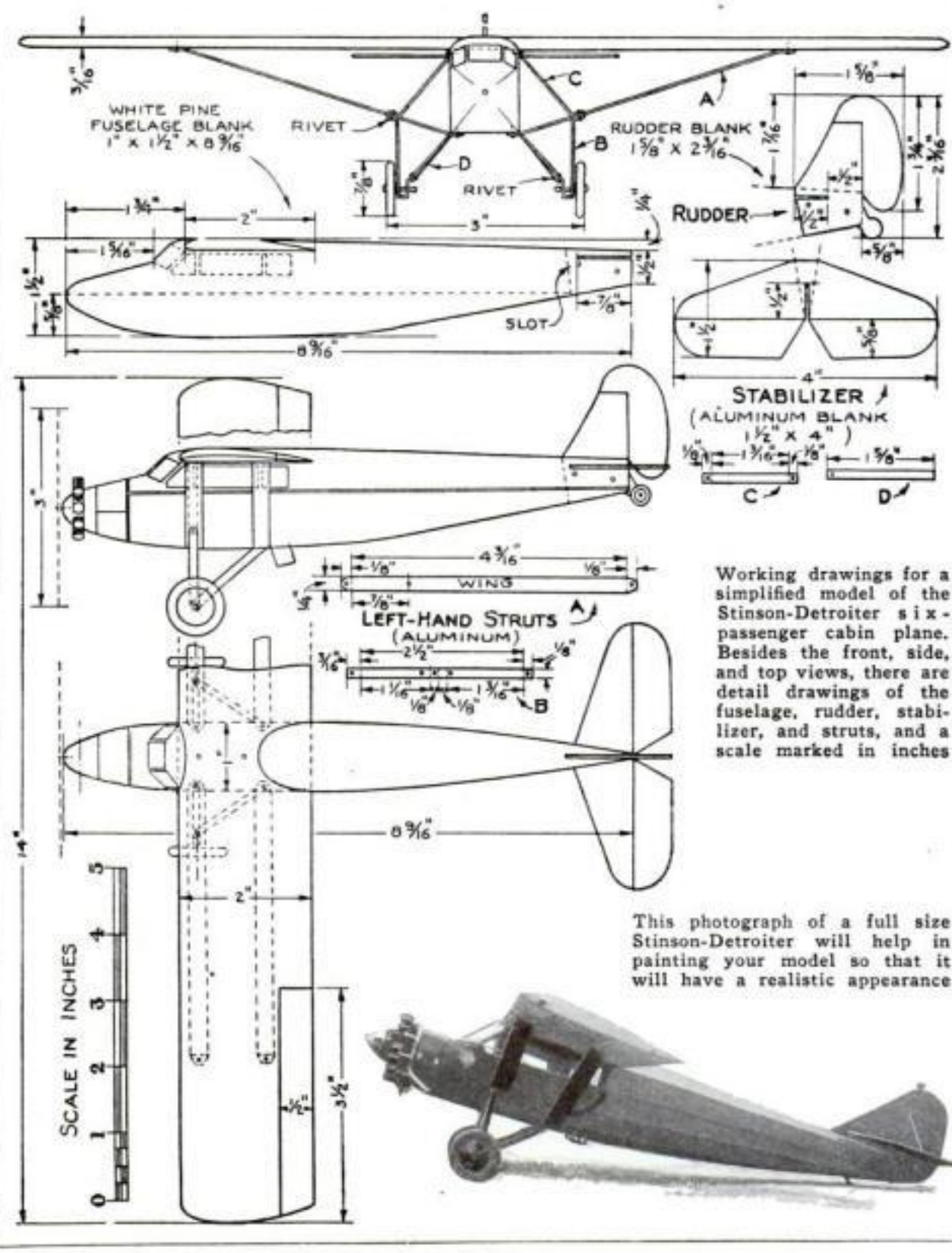
Suitable colors for this model are: Fuselage, rudder, and struts, dark blue; wing, stabilizer, and wheels, light blue; cabin windows, aluminum shaded with blue; trimmings, red; and motor, black.

Many requests have recently been received for a complete list of the airplane articles published in this noteworthy series by Mr. Clark. They are as follows:

In 1930—Twenty-passenger flying boat, April issue; racing seaplane, May; Lindbergh's low-winged Lockheed Sirius (without pontoons), June; the Dornier *DO-X*, July; Bowlus sailplane, August; flying wing experimental model, September; Curtiss Condor transport biplane, October; Ford trimotor, November; and Keystone-Loening air yacht, December.

In 1931—Curtiss Hawk, January; Vought Corsair, March; Travel Air "mystery" ship, April; Burnelli twenty-passenger transport, June; Sikorsky twin-motored amphibian, July; D-7 Fokker war plane, September; and Boeing flying boat, October.

Back copies of the magazine can be obtained for 25 cents each as long as the supply lasts.



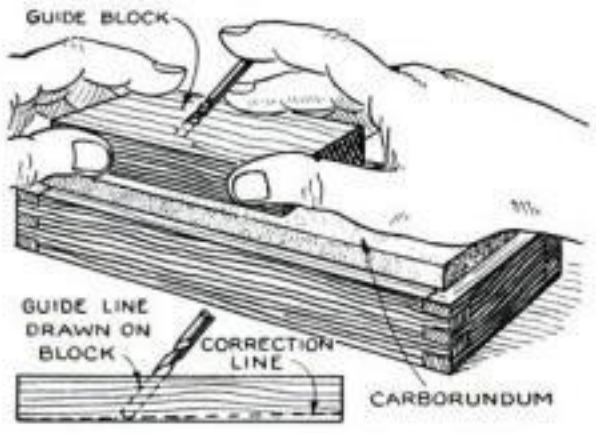
Working drawings for a simplified model of the Stinson-Detroiter six-passenger cabin plane. Besides the front, side, and top views, there are detail drawings of the fuselage, rudder, stabilizer, and struts, and a scale marked in inches

This photograph of a full size Stinson-Detroiter will help in painting your model so that it will have a realistic appearance

BEGINNER'S METHOD OF SHARPENING DRILLS

IN SHARPENING twist drills, the handy man or home workshop beginner usually finds it difficult to keep the cutting faces at the proper angle and both at the same angle. If too sharp, the drill will rapidly become dull at the point; and if one angle is less than the other, that face will do all the cutting.

Drills as they come from the manufacturer have the correct angle (ordinarily 59°). Place the tip of the drill with one

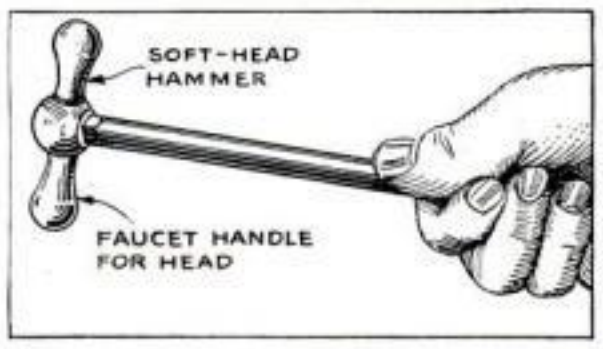


DRILLED HOLE MUST BE MADE ACCURATE BY PLANING BOTTOM IF NECESSARY

cutting edge in close contact with the surface of a hardwood block that has been carefully squared and, using a protractor, note the degree of the angle formed by the shank of the drill and the surface of the block. Mark both edges of the block at the indicated angle and draw another line across the top connecting the ends of these lines. Beginning at the center of the block on the crossline, drill through the block at the desired angle with the drill to be sharpened. Test carefully to assure yourself that the cutting face of the drill comes out on the lower face of the block at exactly the correct angle. If not, plane or sandpaper away the wood until correct. The drill may now be slipped through the block, and block and drill rubbed over an oil stone with full assurance that the correct angle will be maintained and that both faces will be sharpened alike. A half twist suffices to place the opposite face of the drill in position for sharpening.—JACK HAZZARD.

FAUCET HANDLE MAKES SMALL "SOFT HAMMER"

A SMALL hammer made of brass, copper, or lead is of great value in assembling or adjusting fine machinery. A hammer of this sort, small enough to be used for such delicate work as gun repairing, can be obtained without cost by fitting a suitable wooden handle to a brass T-handle taken from an old household water faucet.—V. A. L.



This curious

Triple Dovetail Joint

will puzzle your friends

By ARTHUR L. SMITH

EVERY man and boy who has a home workshop and enjoys making things of wood should appreciate this article. It is the fifteenth in a series prepared especially for POPULAR SCIENCE MONTHLY readers by one of the world's most distinguished authorities on puzzles. Other articles by Mr. Smith will appear from time to time.

With similar dovetails on all six sides, the block looks as if it could not be assembled

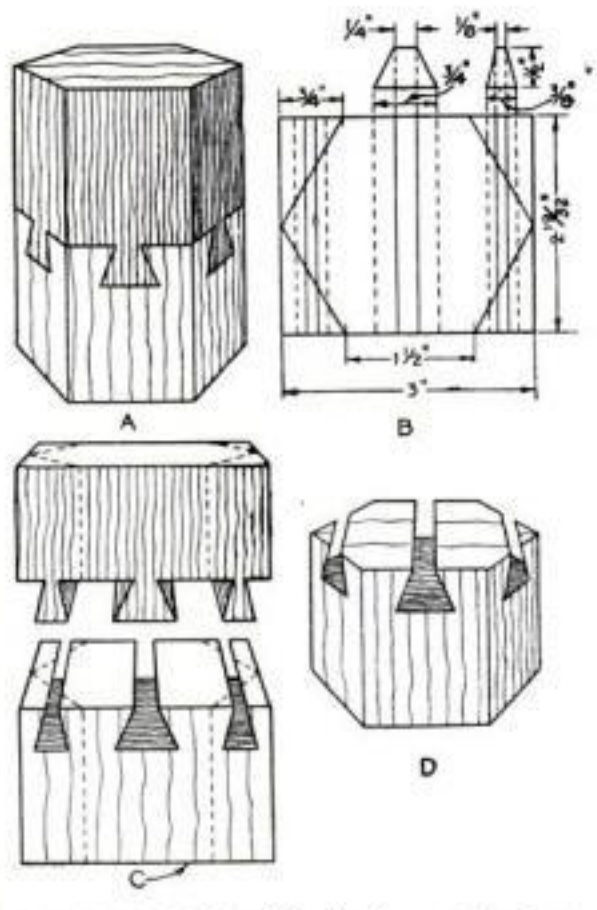
A WOODWORKER can mystify his friends by making the curious triple dovetailed joint illustrated at *A*, which looks as if it were impossible to assemble. It is a variation of the so-called "double-dovetail" puzzle, which is an old stand-by. All six sides of the hexagonal block appear to be dovetailed.

Prepare two blocks 2 19/32 by 3 in. and of any desired length, and make ½ in. deep dovetails as shown at *B* and *C*. The two smaller ones taper from ⅛ to ⅜ in. as indicated in the plan view, but the central one tapers from ¼ to ¾ in. Care must be taken that they cross the sides of the hexagon exactly in the center.

While the blocks preferably should be of different colored woods, one may be stained to contrast with the other, but in this case the final gluing cannot be done until last of all. It is easier to use blocks of different woods; then fit and glue them together; and when the glue is thoroughly dry, plane off the corners to the hexagonal form as shown by the dotted lines of drawing *C*. To make the construction clearer, the lower block is shown completed at *D*.

The dovetails may be varied in length and taper, but if there is any departure from the dimensions given it will require some calculation to have the dovetails appear the same size on all six sides of the hexagon. The secret might be disclosed otherwise. First draw the lines of the smaller dovetail through the lines of the hexagon as *B*. Then with dividers measure the distances on the diagonal lines between the top and bottom of the taper and transfer to the central part of the block for the larger dovetail.

An ingenious woodworker might convert a jointed piece of this kind into various novelties. For example, each block might be hollowed out from the end and fitted with a lid so that the whole would form a double-ended box for jewelry or small trinkets. It would be equally easy to make a toy bank, and other possibilities will suggest themselves.



The finished joint (*A*), laying out the dovetails (*B*), and cutting the parts (*C* and *D*)

PATCHING METAL PARTS WITH IRON CEMENT

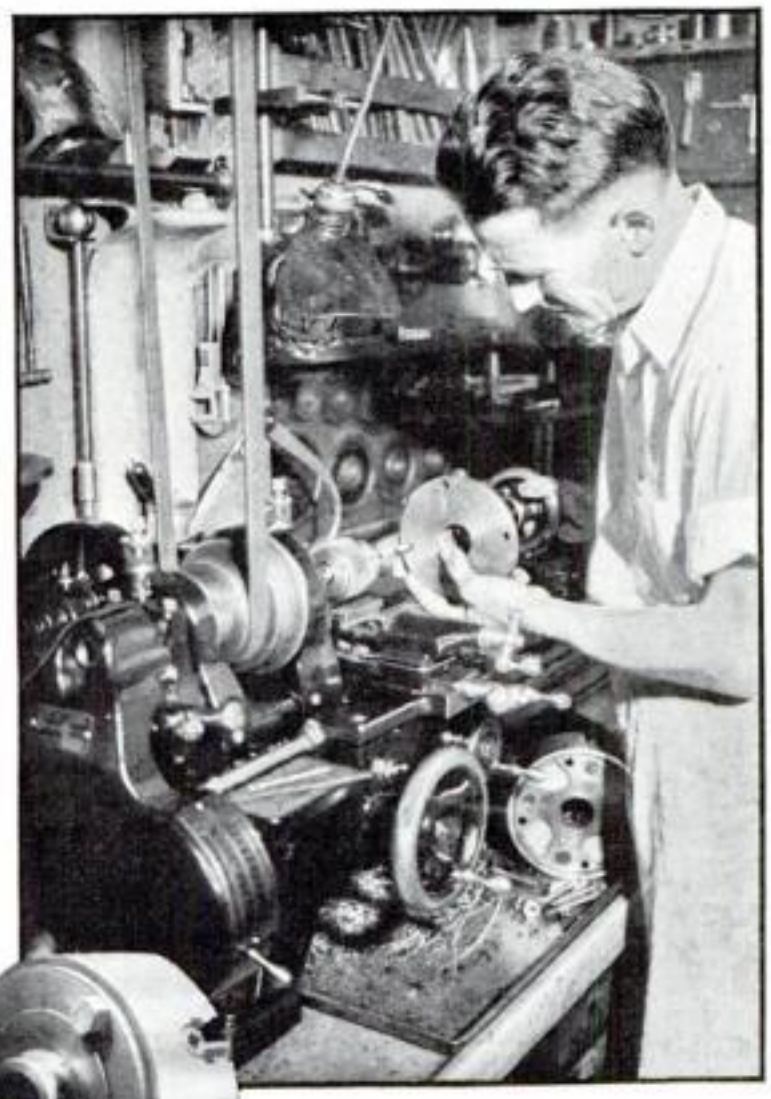
ONE means of making excellent repairs to any cracked iron surface or defective casting is by means of so-called "iron cements." If handled properly, a high-grade cement of this type sets hard and fast and effectively closes any minor defect. Do not just plaster the cement on. Force it into the crack or hole until entirely filled. Apply pressure with a flat instrument such as a stiff knife blade, putty knife, or small trowel. When mending thin metal, it is wise to press the cement in from both sides if possible. Then it forms a sort of rivet, fastened from both sides. If it is forced in from only one side, the surface coating is likely to peel under stress and pull the plug out with it.—L. R.

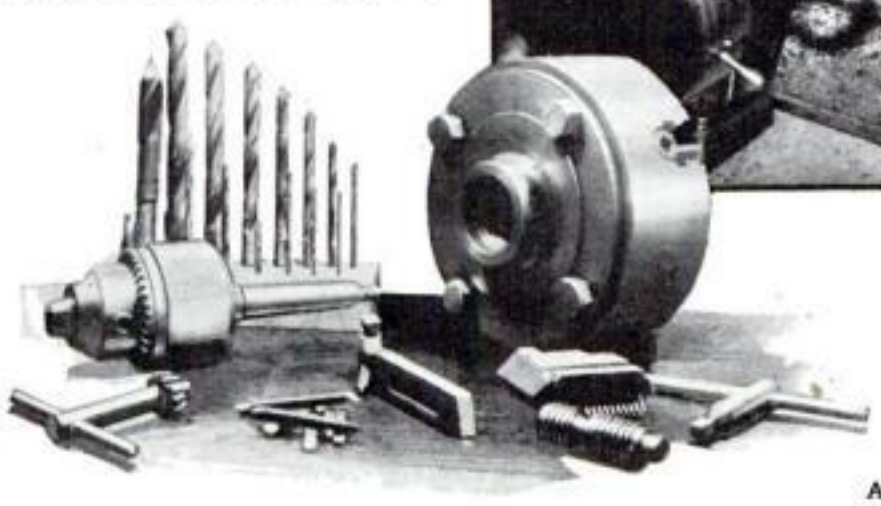
Fitting a Small Lathe Chuck

HOLT CONDON *tells the home machinist how to go about his first important job*

WITH some mechanical experience and a consuming itch to do close machine work in a home workshop, the writer made his initial investment in a 9-in. screw-cutting bench lathe. The tools selected were only those necessary to make a start—a left-hand tool holder with half a dozen tool bits, a drill chuck of ½-in. capacity fitted with an adapter shank to fit lathe spindles, and a 6-in. lathe chuck of the four-jaw independent type. The reason for selecting the independent jaw chuck rather than a three-jaw universal chuck was its far wider range of usefulness.

A chuck adapter plate came as standard equipment, and my first job was to mount the chuck on this plate. It came rough turned and was bored and threaded to fit the spindle nose. The "mak'in's" for the job were now all at hand except a drill; and, of course, a set of drills must be acquired—say from 1/16 to ½ in. by sixteenths.





After it had been faced and turned, the adapter plate is drilled to take the bolts with which it is fastened in the recess provided for the purpose in the back of the chuck

A 9-in. lathe and these tools enabled Mr. Condon to build nearly all his shop equipment

Now for mounting the chuck: After cleaning the threads both on the spindle and in the bore of the plate, it was run on and set up firmly against the shoulder of the spindle. A tool was ground with a rounded nose and very little top angle or "rake." When set level with the centers and at approximately right angles to the plate face, it showed a slight clearance below the cutting edge and pitched back slightly from the shoulder.

With the tool thus set for the facing cut, the carriage was clamped to the ways and the back gears were set for the slowest spindle speed. The cross feed was by hand, and as the cut progressed the belt was stepped up as the surface speed fell off with the reduction of the diameter.

The chuck recess which was to receive the plate was next measured, and a careful transfer made to outside calipers. The plate edge was then turned off to this diameter, the chuck itself being used for the final fitting until it went over in a nice push fit. The bolt holes were scribed through to the plate, which was then taken off the chuck and drilled.

If I had a drill press, the holes could have been spotted through to the plate with the chuck in place, but the drilling had to be done on the lathe. I center-punched the center of the scribed circles. Then, with a hardwood block over the nose of the tail spindle to back up the work and while supporting it in the left hand, I fed it into the drill which had been chucked in the live spindle. In drilling larger holes it is good practice first to drill a lead hole—say ⅛ in.—and follow through with the larger drill, which then cuts with much less heat, requires less power, and produces a truer hole. The chuck was bolted to its plate and, of course, indicated true.

The story of how this small beginning grew into a completely equipped little machine shop will be continued by Mr. Condon in an early issue. He was once the director of a school for shop men conducted by the manufacturer of one of the finest automobiles built in Detroit.

Easily Made Electric Presser Keeps Your Ties Like New

By ERNEST A. RERUCHA

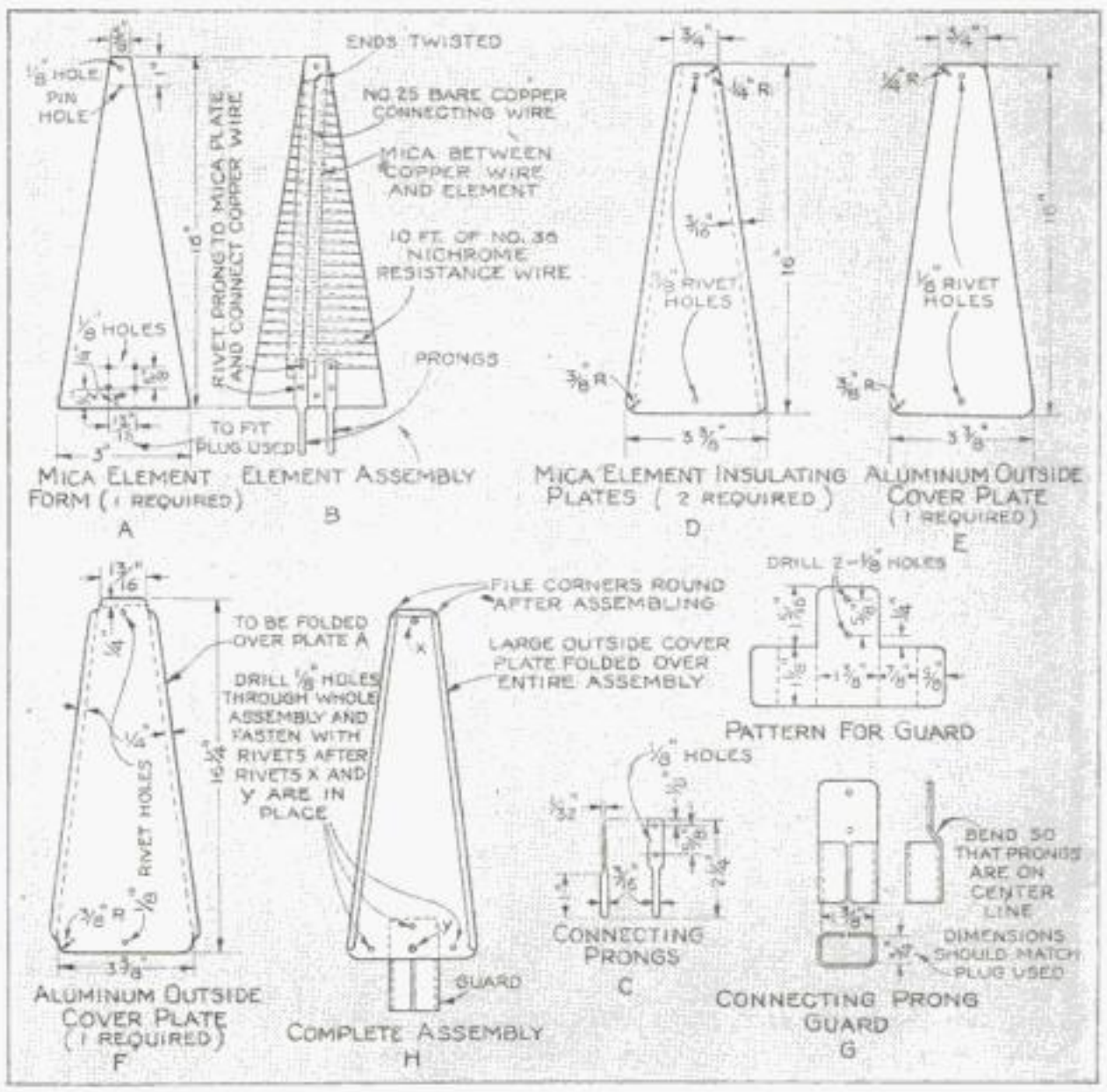
AT A COST of about twenty-five cents for materials, you can make an efficient electric iron for pressing neckties. The whole operation of pressing a tie with this iron, from the time it is plugged in until the tie is pressed, requires about three minutes.

For the heating element the writer used wire from a small electric stove purchased for ten cents at a variety store. The outside cover may be of sheet brass or aluminum, but aluminum is preferable because it is much lighter in weight and adds to the appearance of the completed article.

The required materials are as follows:

1 pc. mica about 3/64 by 3 by 16 in. for the element form.
1 pc. mica about 1/32 by 7 by 16 in. for the element insulators.
1 pc. sheet aluminum 1/32 by 7½ by 17 in. for the outside cover plates or case.
1 pc. polished mild sheet steel 1/16 by 2 7/16 by 4 ⅜ in. for prong guard.
10 ft. No. 36 nichrome resistance wire.
8 tinner's flathead rivets ⅛ by ¼ in.
16 in. No. 25 bare copper wire.
1 pc. copper rod 3/16 by 4½ in. for connecting prongs.

Cut out the element form from 3/64-in. mica as shown at *A*. Insert one end of the resistance wire into the pinhole at the narrow end of the form and bend it back on the other side with an allowance of about 1¼ in. for making a connection. Wind the remainder of the resistance wire about the form tightly, spacing the turns equally so that the last turn does not come closer than about 1½ in. from the wide end of the form, as shown at *B*. It may be necessary first to obtain the spacing



Working drawings of the mica element form and element assembly, the mica insulating plates, the two aluminum cover plates, the connecting prongs and guard, and the complete assembly.

by trial, but there will be about ⅜ in. between turns. Insert the last of the winding through one of the outside ⅛-in. holes at the wide end of the form, and bend it back so that it will not unwind.

Prepare the connecting prongs by flattening the ends of two pieces of copper rod as shown at *C*. Also cut a strip of mica about 1 in. wide and 15 in. long, and punch ⅛-in. holes in the ends to coincide with the holes for the rivets as shown at *B*. This strip is for insulating the connecting wire from the turns on the element form. Attach a piece of No. 25 bare copper wire to the end of the element wire at the narrow end of the element form by twisting the two together securely. Locate and punch a small hole in the mica strip and pass the copper connecting wire through this hole, pressing the strip against the element. Stretch the copper wire tightly along the outside of the strip, bringing it down to the rivet hole. Now rivet the connecting prongs to the mica form with tinner's rivets, with the end of the copper wire under one prong and the other end of the element under the other.

PREPARE the mica insulating plates *D* and aluminum plate *E*. The rivet holes in all these plates must coincide. Also make the other aluminum outside cover plate *F* and the connecting prong guard *G*.

Assemble the element form between the two mica plates and place the aluminum plates on the outside. Set the connecting prong guard in position on the outside of one aluminum plate, and rivet the whole assembly together with two tinner's rivets. These are the rivets *x* and *y* as shown at *H*. Drill two more holes through the plates, one on each side of the guard, and rivet together. Also drill a hole in the assembly to match the other hole in the end of the guard and insert a rivet. In drilling these holes, be careful not to come near the turns of the element or connecting wires.

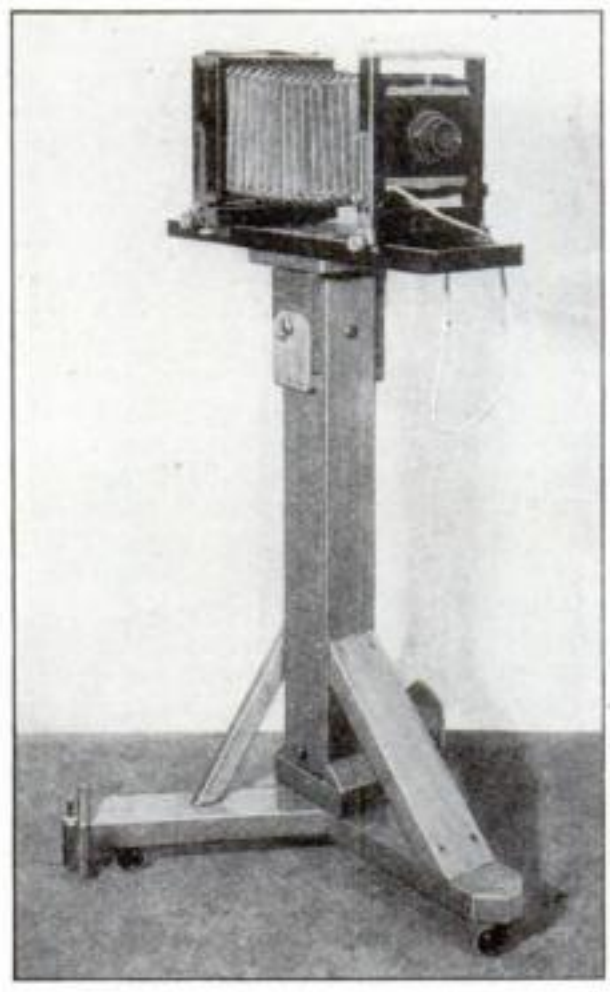
Bend the guard as required so that the prongs are in the center of the opening for inserting the appliance plug. Now clamp the edges of the aluminum plates between two boards in a vise and fold the edges of the larger plate over the smaller one as at *H*. Hammer the folds down evenly with a mallet so that the whole assembly is held together securely. File down any sharp edges and polish with some chalk dust or rottenstone, and the iron is complete.

The connecting prongs will fit any standard appliance connecting plug. To use the iron, simply insert it inside the tie, dampen the fabric slightly on both sides, and turn on the current. Those parts of the tie into which the form cannot be inserted are pressed by using the face of the device as if it were a regular iron.

SOAPING SCREW HOLES

WHEN screws are to be driven into hardwood, it is a good plan to drop some soap beads, soap powder, or fine soap chips into the hole. Some of the particles will fall to the bottom of the hole, and the screw will turn easily all the way in, which it may not do if soap is merely rubbed on the threads.—E. W. W.

QUICKLY ADJUSTED CAMERA STAND



ANY photographer who frequently uses an ordinary folding tripod knows how difficult it is to make quick adjustments with it. Aside from the constant danger of one leg's slipping and wrecking the outfit, it is a tedious job to set up the tripod for close work. To change the height of the camera, the legs have to be altered in length one by one; and if any movement is required nearer to or farther from the object being photographed, the leveling and direction adjustments must be made all over again.

I solved this problem at a cost of less than four dollars by building the camera stand illustrated. With the exception of the head and the side plates hinged to it, it is made from 2 by 4 in. fir lumber. It rolls freely in any direction on cheap rubber tired casters, and when once in position can be locked by means of door stops conveniently placed on the ends of the two rear legs (see drawing at the right).

The camera can be instantly moved up or down and rigidly clamped at any height. Also, the camera may be tilted to right or left at least 30° or forward or backward 90°.

The construction of the base is unimportant as long as it is strong. Do not, however, use more than three casters.

The height adjustment is simple and extremely rigid; indeed, no wobble is possible. Four pieces of "two by four" are planed on all sides, and two corners of each piece are planed or run through the power saw to get the 45° angles shown at section *A-A* in the drawing. The two stationary pieces *S* and *S* are screwed or bolted to the base with a wing-nutted bolt through the tops as shown in the photographs. The two movable pieces *M* and *M* are bolted together at the top against a small block of wood which acts as a spacer. A bolt is also passed through the lower ends and takes a nut which is adjusted to allow motion when the wing nut on the stationary members is loosened.

The top plate, which I wanted to be absolutely warpless, was made by casein-gluing together three ¼ in. thick pieces of plywood. The small side plates can be made this way or from solid lumber ripped from a "two by four."

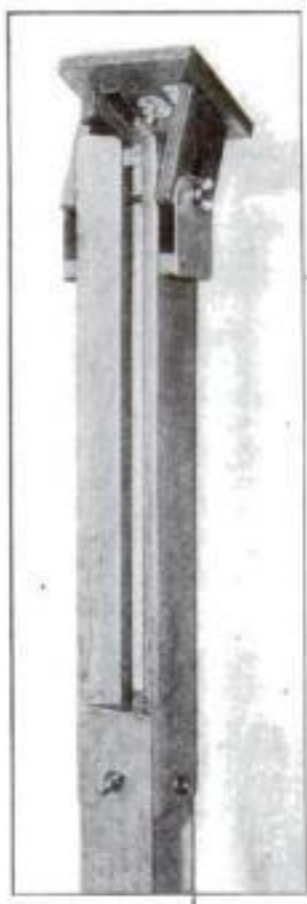
Three hinges are needed. The one at *H* allows for change in the projected width of the top when tipped. The metal plates *P* and *P* can be made of aluminum, brass, iron, or ½-in. wood. As the photographs show, they are attached at their lower edges to wooden blocks to hold them out level with the surfaces of the hinged side plates. They are necessary to clamp the swinging head solidly in any position.

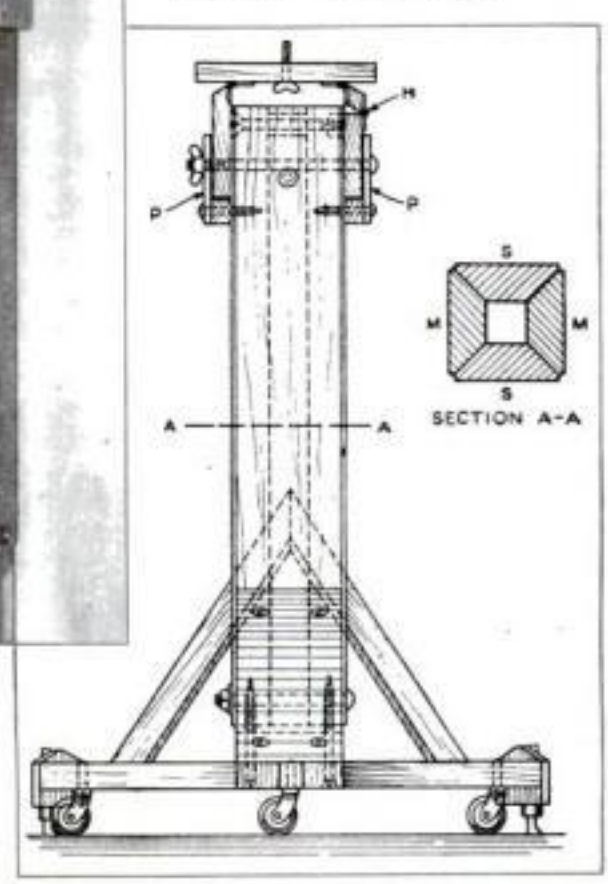
The hinged side plates are, of course, slotted so that they can move up or down to give the side tip. If no side tip is required, these slots and all the hinges may be eliminated.

The construction shown, from 2 by 4 in. lumber, is amply strong for cameras up to the 8 by 10 in. size.

The rigid vertical-sliding arrangement used in this camera stand should also prove practical in building any kind of a table or easel with a height adjustment.

A commercial camera stand, not half as rigid and easily adjusted as this, would cost you more than twenty-five dollars.—F. D. R., Jr.

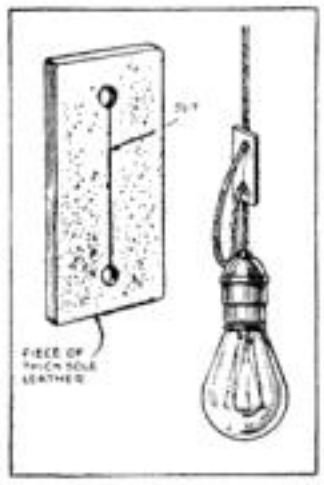




How the stand is assembled and, at left, a photograph showing it extended the limit.

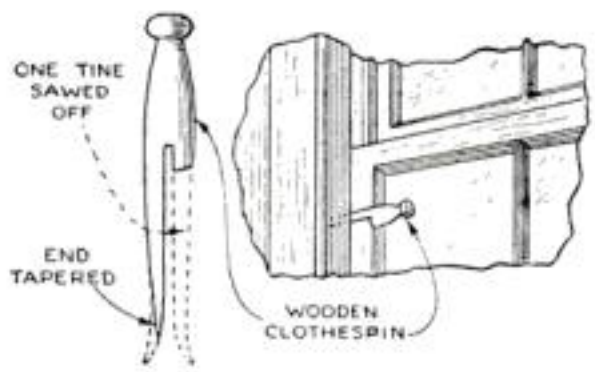
REGULATING LENGTH OF DROP LAMP CORDS

IN MANY basements, attics, and home workshops the electric lamps are suspended from plain cords without even an adjustment ball by which the light can be raised or lowered. An adjuster can be added in such cases as quick as you can say "Jack Robinson." Get an old shoe or belt and cut out a piece of thick, heavy leather 1 in. or more wide and 3 in. long. Punch a hole near each end as large as the lamp cord; then connect these two holes with a slit in the leather as shown. Loop the cord, push it through the slit, and spread the loop until one part of the cord fits into each hole. The slit should then close and the leather straighten out into normal shape. To adjust the height of the bulb, it is then necessary only to pull the cord through the holes until the loop is as large as necessary to bring the lamp to the desired position.



WINDOW WEDGES MADE FROM CLOTHESPINS

WHEN the wind blows hard and all the loose windows in the house begin to rattle, it is hard to sleep—and harder still to find wedges to silence the sash. Wedges should be kept on hand for this purpose. The easiest way to make them is to cut one tine from each of a number of wooden clothespins and sharpen the remaining tine so that it has a chisel-shaped end. Clothespins treated in this way will also serve as wedges for other purposes about the house and home workshop.—L. B. R.



How the clothespin is altered and used as a wedge to prevent windows from rattling

FIGURING SPEEDS FOR CUTTERS AND SAWS

FOR highest efficiency, motor-driven woodworking cutters and saws should be run at a peripheral speed of about 9,000 ft. a minute. For example, for an 8-in. circular saw the best speed is approximately 3,500 R. P. M. A saw traveling at this speed suggests danger, but as a matter of fact a sharp saw running at this speed is far safer than a dull one running more slowly.—K. C.

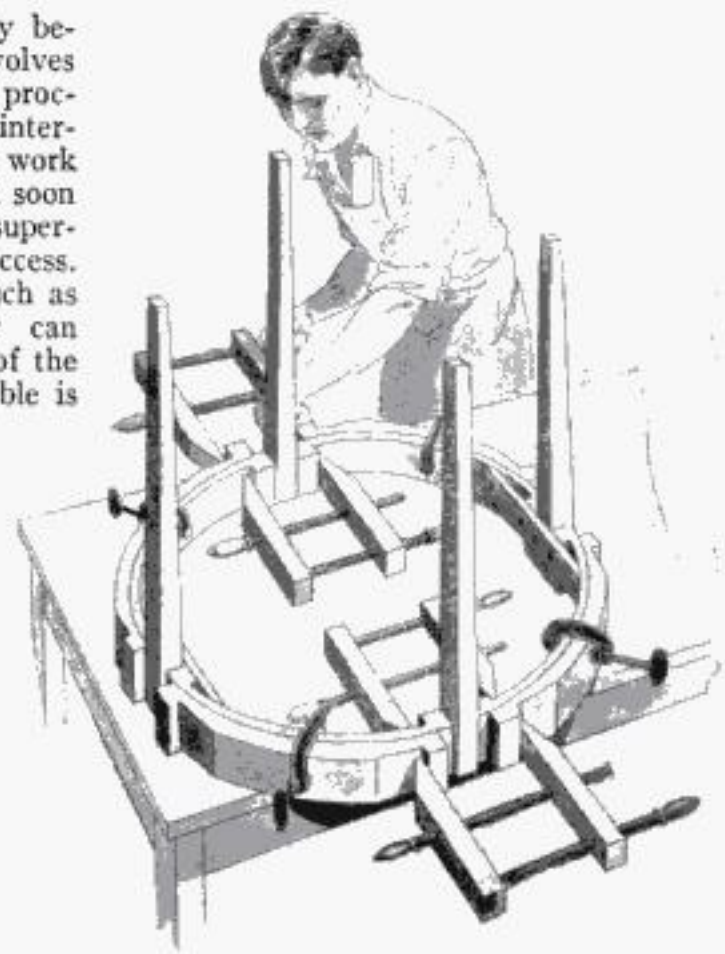
A little patience goes a long way in

Doing Circular Woodwork

DAVID WEBSTER *gives suggestions on the simplest methods of building a round card table and similar pieces of furniture*

AMATEUR woodworkers usually believe that circular work involves very difficult and intricate processes. Their timidity closes a most interesting field of endeavor, for if curved work is approached sanely the worker will soon realize that patience rather than superskill is the element that insures success.

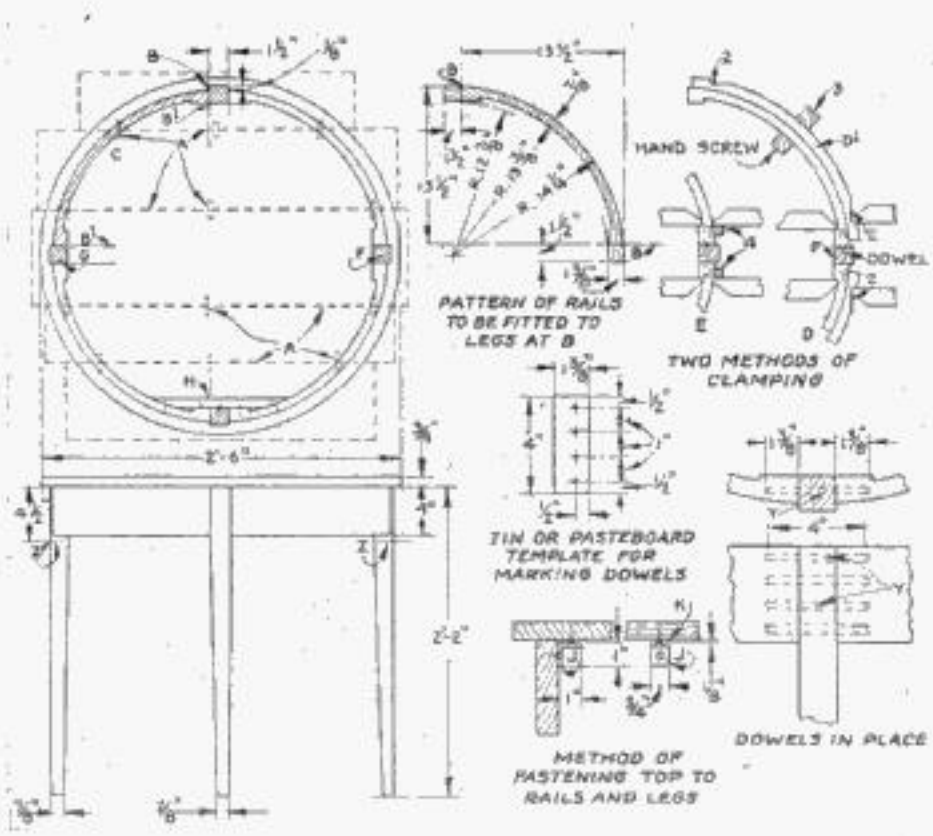
By making a round card table such as the one illustrated, the beginner can quickly learn the general principles of the work. We shall assume that the table is to be of mahogany, although any wood may be used. The top is ¾ in. thick and 30 in. in diameter, dowel-jointed and glued as suggested by the dotted lines *A*. Plane its underside reasonably smooth and draw on it the full size plan of the legs and rails as shown. This drawing will give all the necessary angles.



Completing the assembly of the table frame with the aid of wooden forms clamped to the rail segments.

Prepare the stock for the legs, 1½ by 1½ by 26 in. For making the rails, two methods may be used. They may be cut from a plank a full 4 in. in thickness, 12 in. wide, and 21 in. long, or each rail may be glued up of 1 in. thick pieces and veneered. In fact, even if the rails are cut from the solid wood, they may be veneered, but as we are principally interested in the general method of construction, we shall not discuss veneering at this time.

Make an accurate pasteboard pattern as shown, mark the four rails upon the plank, and band-saw and smooth the face of each, being careful that its form is not changed at the ends where the rail joins the legs. Draw lines B^1 on the plan beside each leg. From now the work will be largely upside down, so lay each rail in its place as at *C*, holding it with hand screws if necessary. Mark the exact length of the rail between lines B^1 on each end, and with knife point and try-square mark accurately across the face of the rail, and the angle of B^1 across the edges. Cut exactly beside these marks with a fine, sharp saw.



Working drawings of a round table; details of the rail pattern, doweling template, and joints; and methods of clamping and fastening the top.

Be sure the top is firmly supported and is resting straight and practically level. Then try clamping the joints at *B* together upon it. Either of the methods illustrated may be followed, but the writer prefers method *D*, in

which four forms are sawed from 2-in. plank of any kind of wood as at D^1, with notches cut at *2* as shown. If the forms are firmly held against the rails with hand screws or heavy C-clamps as at *3*, the efficiency of the method is obvious. Method *E*, however, is used by many workmen; in it, blocks are glued as at *4*. It is simple and convenient; and if the blocks stick when the strain is applied, it is efficient. Nevertheless, when the blocks are cut off later, a blemish may result.

Place the two rails upside down, with the top end of a leg, for example *F*, in its place on the plan. With hand screws, draw the rails into place and hold them. Note that the face of the rails are set ⅛ in. back from the face of the legs. If the leg stands straight both ways, if the face of each rail coincides with its line on the plan, and if each joint bears firmly and is tight, we may call it a fit. Number these joints so there will be no hesitation in placing them again, and repeat the operation at each remaining leg.

AFTER all joints have been fitted in this way, set all the legs and rails up together. See if opposite legs are parallel, and line up well when you sight across them. A little more fitting may be necessary, but usually the dowels when in place will have enough play to allow the legs to be moved into position.

Make a tin or pasteboard template for marking the dowel holes. With its aid, mark each end of each rail, using a scratch awl. Make corresponding marks on the legs by setting the front edge of the template back ⅛ in. from the face to coincide with the ultimate position of the rails. Be sure that the same edge of the template is used for the top every time.

Bore ⅜-in. holes 1⅜ in. deep in the end of each rail, and bore the holes in each leg from each side, meeting in or near the middle of the wood. Cut ⅜-in. dowels 4 in. long, push them through the legs as at *Y*, and assemble rails and legs according to the number previously marked. Each separate dowel should fit its holes with a gentle push fit; and when the fitted joint is assembled, be sure it can be pushed together with no pounding or undue use of strength. Then take the frame apart.

BEGINNING 4½ in. from the top of the leg as at *Z*, taper each to ⅞ in. at the bottom, leaving the outside straight. If this were done before, it would make lining up more difficult, and the legs also might become bruised.

Smooth and sandpaper the legs and rails. Place the clamping form D^1 on each and be sure the hand screws and all necessary aids are at hand. Unless the room is warm enough for gluing with hot glue, say from 75° to 80° F., and the worker is certain that he can assemble each leg and its rails before the glue sets, he should use casein glue; in fact, the latter conduces to safety anyway. If casein is used, do not remove the clamps for at least twelve hours.

Assemble leg *F* with its rails, placing the glue in the holes as well as on the joining surfaces. Apply the clamps with all the speed and certainty possible. Hold the rails in place on the board with hand

screws, if desired, but be sure the legs stand straight and parallel when left to harden. Do the same with leg *G*.

There should be little trouble, when this work has been done, in assembling the two other legs. Since the joints on each side should go together simultaneously, a helper will be found useful. In any case, the final sighting and straightening of the legs should be done while the joints are moist. Fasten stay laths with hand screws to hold the legs in their correct relation until the glue has thoroughly hardened. Fit four reënforcing blocks 3 in. wide as at *H* and fasten them with glue and screws. The table will be as rigid as it is possible to make it.

SHAPE the edge of the top with a band saw or, if none is available, a compass saw or a turning or frame saw. Smooth and true it up with a spokeshave or a circular plane and finish with file and sandpaper.

Joint (plane) the top of the rails and legs to fit the underside of the top. Fasten eight ¾ by 1 by 1 in. angle irons to rails and legs as shown at *J*, placing each ⅛ in. from the top of the rail as at *K*. Turn the top upside down, place legs and rails in their correct relation to the edge of the top, hold them in place with hand screws, and drive screws through *J* into the top.

Go over every corner with fine sandpaper, not to round the corner perceptibly, but to remove the burr. This is one of the fine touches of the skilled workman and makes the finishing easier, but it must not be exaggerated.

Stain, fill, and varnish the table, or finish it in any way desired.

TESTING FOR DAMPNESS IN CONCRETE FLOORS

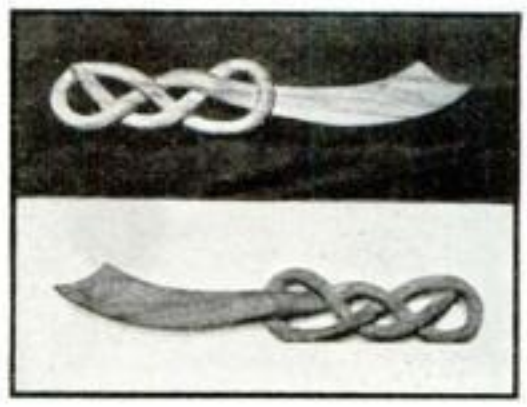
THE presence of moisture in new concrete floors, which must be dried out before a final covering can be put on, can be readily determined by either of two simple yet dependable tests developed by a company that manufactures cork brick, cork tile, and linoleum.

The more sensitive test is to place on a 2-in. watch crystal a quarter-teaspoonful of anhydrous calcium chloride, which can be obtained at any drug store. Set the crystal on the floor and cover it with a 5-in. clock crystal, embedding the edges of this cover in soft putty. It is important to have the joint air-tight. Within twenty-four hours any dampness in the floor will make the calcium chloride wet, and any large amount of moisture will dissolve it.

A simpler but probably less accurate method consists of placing pieces of linoleum face down on the floor, weighting the edges, and allowing them to remain for twenty-four hours. Under ordinary circumstances the presence of any moisture in the flooring will be shown by dampness between the floor and the linoleum.

In making these tests, it is advisable, for conclusive results, to test several different portions of the floor, as one part of a large floor area may be dry while another is still damp. A new suspended floor usually becomes thoroughly dry in from two to four months, depending on climatic conditions.

PAPER KNIFE WHITTLED WITH HANDLE LIKE INTERLACED KNOT

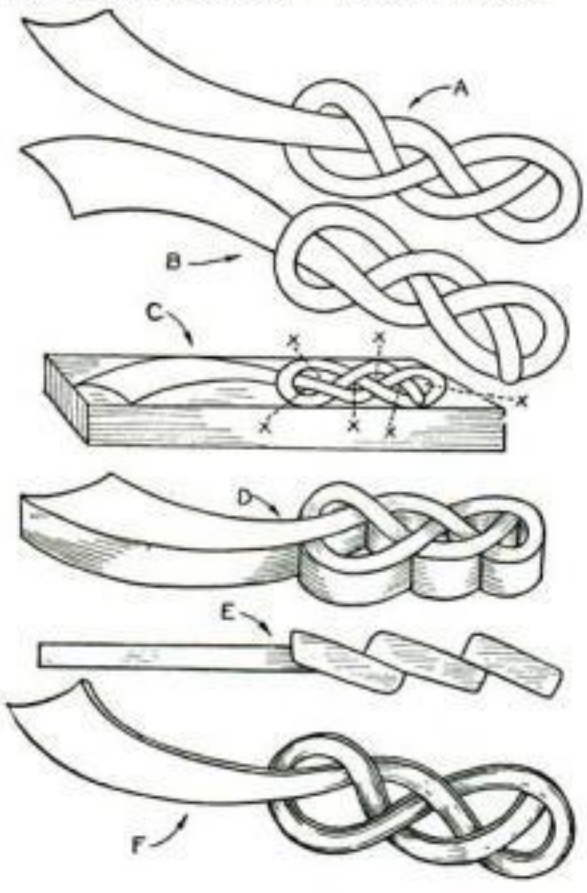


WHITTLED from a hard or semihard wood such as walnut, maple, or Australian gum, this paper knife makes a useful and curiosity provoking ornament.

The stock is 5/8 by 1½ by 8 in. Draw the design *A* on a piece of paper and cut out with knife or scissors. Lay this pattern on one side of the block and run a soft pencil around the entire outline. Save the pattern; you will need it later. Indeed, it is well to draw the handle details on the reverse side of the block, being sure that it follows closely the plan shown at *B*. Remember that the parts interlace with one another. Where a section crosses *over* on one side, it must cross *under* on the other. The two sides of the diagrammed block will now be similar to *A* and *B*.

The work is next outlined with knife or saw as at *C*, the parts marked *X* being cut right through as shown at *D*. Keep the work progressing evenly on both sides until it appears as in the edge view given at *E*. When the ribbon parts have been reduced to a uniform thickness, round them off by whittling away the sharp corners. Do not try to take all the wood off at once; work around and around, keeping the outlines smooth as you go. Bevel the blade to a thin edge as at *F*, and sandpaper the whole smooth.

The knife may be left unfinished or waxed and polished.—W. L. FAUROT.



Outlines *A* and *B* are marked on block *C*, and it is shaped as shown at *D*, *E*, and *F*

Rolling Motor for Bench

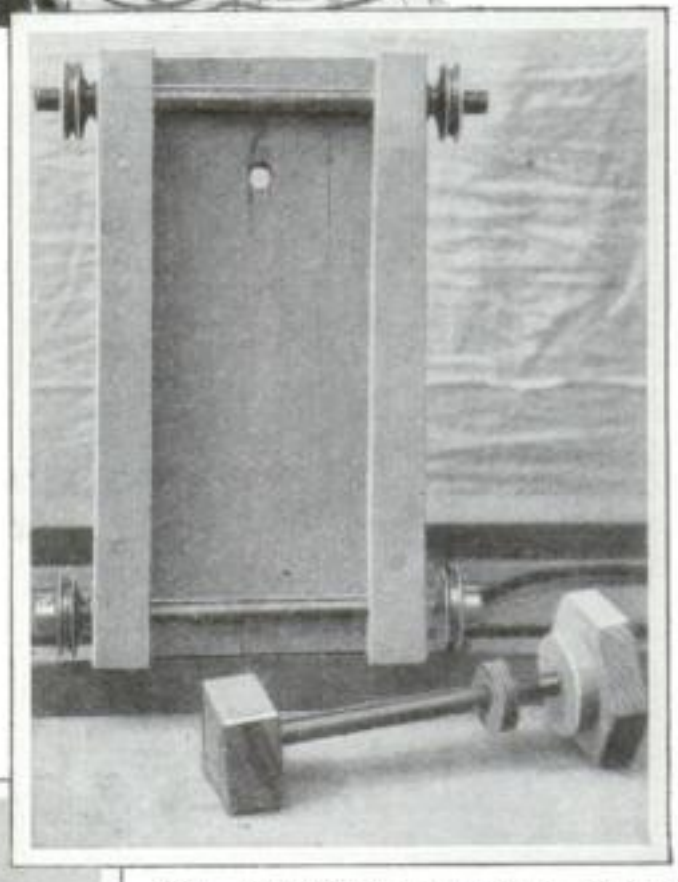
It can be moved quickly on tracks to drive several different machines

By
M. CYLE SMOCK JR.

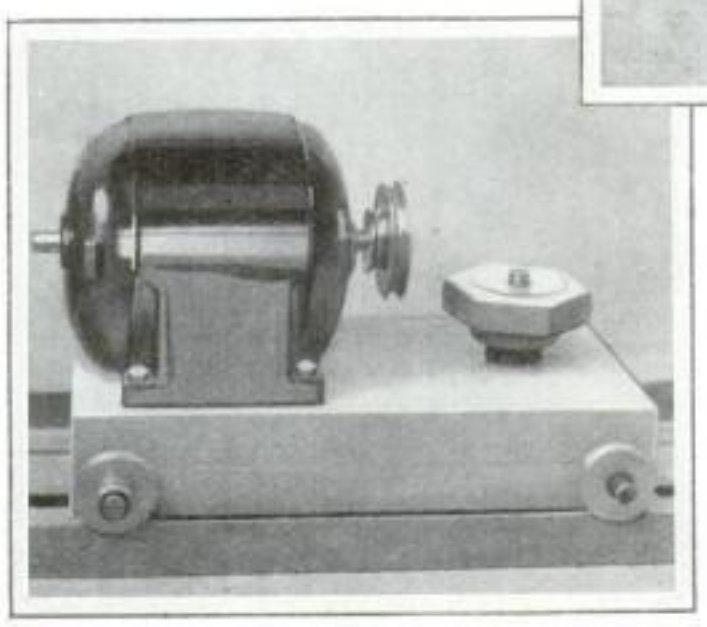
With an arrangement such as this one electric motor provides an individual drive for each of your small machines.

THROUGH the use of the ingenious movable motor illustrated, it is possible to enjoy the convenience and efficiency of a direct motor drive on each machine in your home workshop with but one motor and at less than the cost of a countershaft.

The machines are placed in a row along the front edge of the bench, and the motor is mounted on a truck that can be rolled along two angle iron rails. When it is desired to operate one of the machines, the motor is moved to a position directly behind the tool, the locking bolt is tightened, and the belt is run over the pulleys. The motor can be shifted thus from one machine to another in almost as little time as it takes to move from one tool to the other.



The underside of the motor carriage and the locking bolt and handwheel.



The motor mounted on the truck. A long electric cord leads to the motor from the rear of the bench.

As shown in the drawings on page 126, the construction of the motor-carrying truck is quite simple. It is made up of a 1¼ by 7 by 12½ in. block of hardwood, either maple or oak, and two 1 in. square strips which are fastened to the bottom along the sides and serve to hold the two ½ in. diameter axles in place.

The wheels used by the writer are four two-stepped pulleys, 1¾ in. in diameter. Such pulleys can be purchased for about twenty-five

A definite program for getting ahead financially will be found on page four of this issue

cents each. Since it is necessary that the wheels turn freely on the axles, they are held in place with shaft collars rather than with the set screws provided. These set screws can be removed.

A square-headed machine bolt, ½ in. in diameter and 8 in. long, forms the locking screw. Its head is set into a mortise in a hardwood block 2 in. square and ⅞ in. thick and having a ½-in. hole drilled through it so that it can be slipped over the shank of the bolt. The head is prevented from dropping out by nailing a piece of tin over the block.

THE handwheel is hexagonal and can be cut from a hardwood piece ⅞ by 4½ by 4½ in. To the bottom of this is nailed a hardwood disk ½ in. thick and 2 in. in diameter. A square mortise large enough to take the nut is cut in the top surface of the handwheel; then the nut is dropped into place, and a 2 in. diameter disk of tin is nailed over the top. This disk, of course, also requires a ½-in. hole through its center to pass the threaded end of the bolt.

For the two rails, the writer used ⅛ by 1½ by 1½ in. angle iron. The rails of an old iron bed or cot will be found just the thing if the builder cannot obtain the stock in any other way. These rails are fastened with ½ in. long screws to the bench top on both sides of a ¾ in. wide slot. This slot, which serves to take the locking bolt, can be cut in the bench top with a hand saw after holes have been bored for starting the saw. Care must be taken when placing the rails to see that the truck rolls freely for the entire length of the bench.

Last of all, fasten two ¼ by 1 in. wood strips to the underside of the bench top, one on each side of the slot and spaced so that the 2 in. square block on the end of the locking bolt will slide easily between them, thus preventing the bolt from turning.

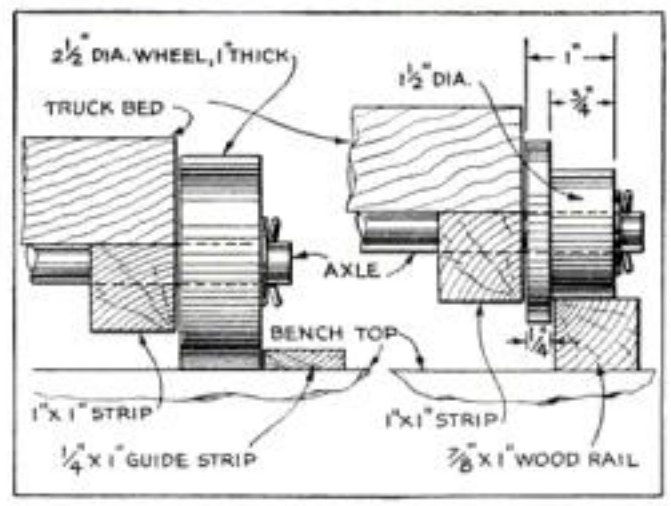
A TRUCK built to the suggested dimensions is large enough to carry a ¼- or 1/3-H.P. motor. Mount the motor with 2-in. screws or stove bolts, placing the pulley end toward the handwheel end of the truck.

The motor cord should run to an outlet in the wall directly back of the bench or to a fixture on the ceiling immediately above the bench. Allow enough slack for the free movement of the motor.

The reader must understand that there are no hard and fast rules in regard to the construction of truck and rails; each installation presents its own problems. Hardwood wheels, turned 2 in. in diameter with a ¼ in. thick flange, for example, can be used in place of the metal pulleys the writer used. Wooden rails 1 in. wide and ¾ or ⅞ in. thick may be used instead of the angle iron rails.

Still another way is to use flat-faced wooden wheels 2½ in. in diameter and 1 in. thick, and place the truck on the bench top itself, using ¼ by 1 in. guide strips on either side of the wheels.

As to the size of the bench used, that depends, naturally, on the available space and on the number of machines. For mounting machines in a row, a bench top 30 in. wide and 8 ft. or more in length



If desired, wooden wheels and rails may be used in place of the pulleys and angle iron.

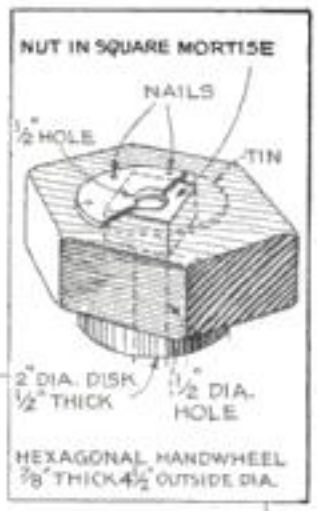
will be found adequate. If the shop is small, a bench with a top 4 ft. wide and 6 or 8 ft. long can be used, with the truck running down the center and the machines placed on both sides.

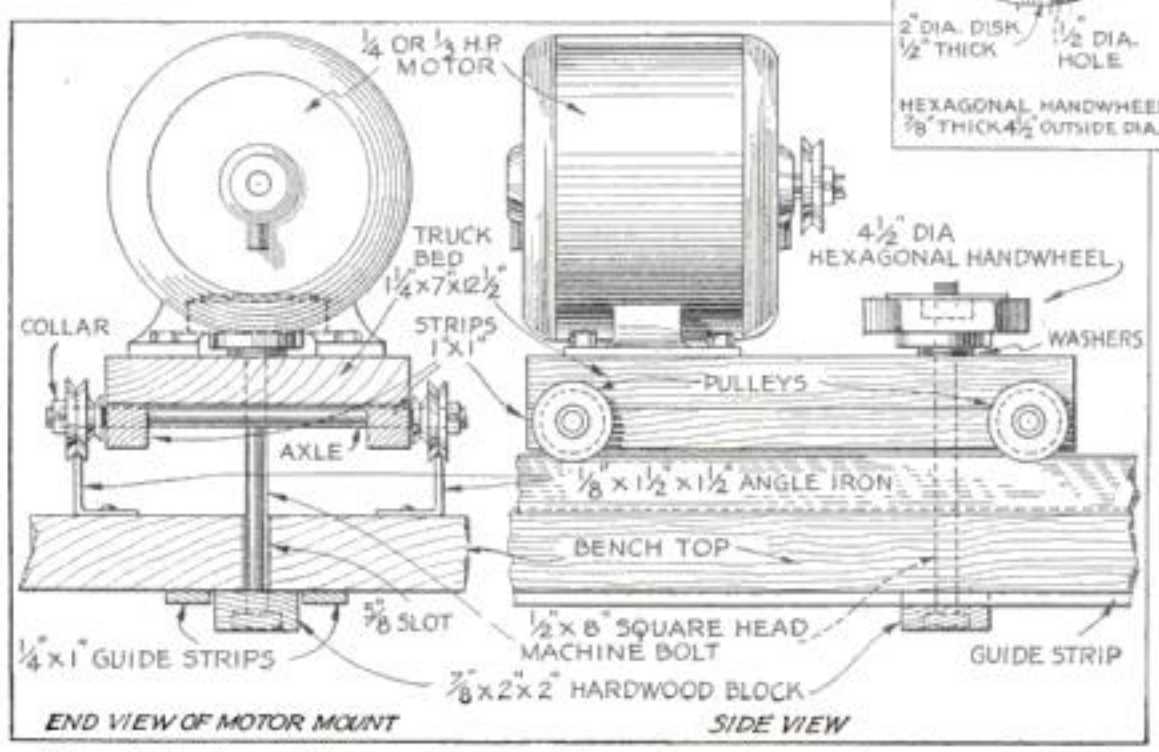
In setting up the machines, there are several rules to be observed if satisfactory service is to be obtained.

Place the jointer at the extreme left end of the bench, never in the center or at the right-hand end, as one stands at the left-hand corner when using a jointer, and to place it in the center or at the right-hand end of the bench necessitates an awkward position when using it.

The circular saw also should be placed at the left-hand end of the bench, just to the right of the jointer, provided the table tilts to the left. If the table tilts to the right, the saw should be at the extreme right-hand end of the bench. Be sure that there is ample clearance for the circular saw table so that you can rip or crosscut without having the work strike any of the other machines.

Fasten the machines down with bolts placed in slots in the top of the bench to allow adjustment of the belts.





End and side views of the assembled traveling motor carriage and a perspective sketch showing the construction of the 4½ in. diameter wooden handwheel for the locking bolt.

A CLASSIFIED FILE HOLDS INTERESTING ARTICLES

READERS who wish to preserve interesting articles clipped from POPULAR SCIENCE MONTHLY in a convenient and readily accessible form can do so by the following method:

Save all the ideas to which you think you will ever wish to refer by removing the entire page on which they appear. Do not simply tear out the page, but remove it carefully by taking apart the binding. These clipped articles are then placed in a cardboard folder until sufficient material has accumulated for a scrapbook.

The first problem is to collate these articles under general heads such as: Machine Shop, Miscellaneous, Auto Kinks, Things to Make, Repairs in the Home, and so forth. When these are all separated, prepare strips of typewriting paper 2 in. wide and 11 in. long and make holes in these by clamping them between two pieces of wood and drilling through all with a brace and bit. Glue one of these strips to the inner margin of each page so that the holes will extend beyond the edge. A suitable and durable cover of cardboard is then provided, and the book bolted together. If desired, index tabs can be glued to the first pages of each subdivision.—A. L. EVANS.

HOW TO IMITATE METAL FITTINGS ON MODELS

BY GIVING boxwood a metal finish through the use of black brushing lacquer (cellulose enamel) and colored bronzing powders, the model maker can successfully simulate small metal parts.

The writer made some anchors which are so realistic that an expert machinist on viewing the model marveled at the intricate metal work. These were carved to shape from boxwood, coated with black lacquer, and dusted with pale blue and flame red bronzing powders, together with natural rust sifted through silk. The surface was daubed with a brush to deaden the colors.—SIDNEY C. HELPS.

SHOULD I PATCH OLD TIRES?

(Continued from page 74)

flivver tires did a few years ago," Gus replied. "I can remember paying exactly fifty dollars and twenty-five cents for two new flivver tires with tubes back in 1917 or 18. Twenty dollars will buy you a much bigger and better tire today. Besides, the price of tires is about in proportion to the price of cars, so if a man can afford a big car, he can afford to keep its wheels properly shod. The way to save on tires is to treat them so they'll give you plenty of mileage before they start to go bad."

"How can you do that?" asked Stoddard.

"Well," said Gus, "one thing you can do is to figure out how much your tires ought to bulge at the road surface when they're properly inflated and then keep them to that bulge by changing the pressure to suit the load in the car. It's simple enough. You inflate the tires to the recommended pressure. Then with your eye directly in line with the center of the rear shoe, and a full load of passengers aboard, make two lines on the garage floor so they appear to touch the sides of the shoe at the bulge. Now let the passengers get out and you'll note that the bulge shrinks away from the lines. Let out air till the bulge swells out to the lines again and note the pressure.

"YOU'LL get a lot smoother riding and longer life out of the tires if you keep them inflated exactly to the right point all the time. This idea of pumping the tires only when you can see they're beginning to get flat means blow-outs and junked tires.

"Another thing," Gus continued. "When you start on a trip with extra passengers and a lot of baggage, do you put more air in your tires?"

"No, is that necessary?"

"Certainly," Gus emphasized. "There ought to be enough more air in the tires so they show only the normal bulge."

"What else is there I can do to make 'em last longer?" Stoddard asked.

"Plenty," laughed Gus. "Flashy get-aways are tough on tires. So are quick stops. Rubbing the sides of the tires against curbstones is another way to kill mileage. And when you pick a service station, try and find one where the service man knows how to get a shoe on without pinching the tube. Lots of flats come from pinched tubes."

"Well," hesitated Stoddard, "I think I'll fix the tire this time anyhow, but when it blows maybe I'll take your advice."

"You were just wasting your breath on that bird," Joe remarked as Stoddard drove away.

"I'm used to it," Gus grinned. "But you and I would have a tough time making a living if it was possible to make the average owner take proper care of his car."

I-BEAM INVENTED BY NATURE FOR TREES

LONG before it was put to work in building skyscrapers, the I-beam, strongest form in structural steel, was invented by nature. University of Washington botanists were recently puzzled by a grove of huge pine trees, rooted in the yielding surface of a bog near Seattle, that remained upright against the strongest winds in apparent defiance of the laws of gravity. They examined the shallow roots. Practically none of the older roots were round. Most of them had taken on the familiar I-beam and T-girder shapes of structural steel. According to the botanists, these roots probably took their shape gradually in response to the constant uprooting force upon them.

Fighting Fires High in the Air

(Continued from page 37)

and the uneven pull of the two-cylinder motor wiggled the hub plate back and forth until friction ignited the wood. Finally, the bolt holes burned so large the whole propeller tore away.

There are three kinds of fires in aviation: flying fires, that take place in the air; ground fires, that occur while a plane is standing on the airport; and crash fires, resulting usually from opened fuel tanks in crack-ups.

A FEW years ago, at Wright Field, Dayton, Ohio, the Army conducted a long series of tests in crash fires. Planes, with engines on full, raced down concrete runways into brick walls while high-speed movie cameras recorded what happened when they hit. The films showed that long exhaust pipes might increase the danger of fire and that the hot oil from the motor sometimes catches fire instead of the gasoline. Cutting the ignition switch, when a crash seems likely, and thus stopping the motor, is standard practice among pilots. It reduces the hazard of crash fires which might result from residual flames in the exhaust pipe.

Early in 1916, I was testing a Gnome-motored Avro training plane near Dover, England, when I had my first adventure with fire in the air. I was circling over the headlands of the coast when my whirling engine sputtered, backfired, stopped. At the same instant, black, oily smoke poured over the cockpit.

I cut the fuel and sideslipped hard to the left. The rolling smoke and shooting flames streamed to the right. The cockpit grew as hot as an oven. For probably fifteen or twenty seconds—which seemed like hours because we never wore parachutes in those days—we plunged sidewise through the sky trailing smoke and flames. Then the black cloud began to decrease and finally stopped altogether. I made a forced landing near the white chalk cliffs that border the English Channel and found that the joint of a fuel pipe back of the motor had broken, squirting high-test gasoline over the red-hot engine.

Because the constant vibration of flying sometimes crystallizes the metal in pipes, the copper fuel lines in many military planes are removed and softened by fresh annealing after every fifty hours in the air. Rubber pipes cannot be used; gasoline softens and dissolves them, carrying particles to the carburetor, causing engine stoppage.

MANY long-distance planes are equipped with copper pipes covered with rubber. If the metal breaks, the outer covering will prevent leakage until repairs can be made. The big air-liners on the London-Paris route have recently adopted a fuel pipe system made of pig-gut, obtained from animals that grow in India. This material is not dissolved by gasoline and is not affected by the constant vibration of the big engines. It is fitted over a wire coil to form the pipes.

Whenever a pipe breaks or a serious leak develops near the engine, it not only floods the motor compartment with inflammable fuel but suddenly decreases the strength of the mixture reaching the power plant, producing a backfire that ignites the escaping gas. Probably nine-tenths of all flying fires begin with backfires.

An invention which promises to eliminate this source of danger is known as the "Air Maze." Fitted to the air intake on the carburetor, it contains a fine copper gauze which operates in the manner of a Davy lamp, rapidly conducting heat away so it cools the flame of the backfire before it can do any damage. This device is now part of the standard equipment on a number of American motors.

Even more common than breaking pipes, in the old days, were sticking carburetor needles. In 1916, soon after the big twelve-cylinder R. A. F. motor was adapted for use on war planes in England, I took one up for an altitude test near Coventry. The day was perfect. At 10,000 feet, I could see the North Sea, nearly a hundred miles away. When the tests were over, I cut the big motor, pulled the ship up into a stall to stop the whirring propeller, and started the long glide to earth. The greatest fun in flying is soaring with the motor off and the propeller stopped. It is like riding a hawk circling over the green countryside. It took me six minutes to get down to 1,500 feet. Then I switched on the engine and dove to kick over the propeller.

Photo shows how flames ate through the nacelle of Courtney's ocean plane, forcing him down on the Atlantic. . . .

All during the glide, the carburetor needle had been sticking, pouring gasoline into the engine compartment. More than a gallon lay ready for an igniting spark. The cold engine coughed, then, with a report like a shotgun, spit flame back through the carburetor and we were afire. With the fuel cut and the ship in a violent sideslip, I headed for the Coventry field.

EXCEPT for a few holes near the exhaust pipes, the metal cowling entirely surrounded the engine. Choked for air, the fire burned in a series of spurts. I could hear it going "blop—blop—blop," at each spurt belching flame and smoke. I came out of the sideslip only a few feet from the ground and when the plane stopped it was no more than a hundred feet from the hangars where mechanics had rolled out the big fire extinguishers that conquered the flames.

Nowadays, it is required that the cowling on all planes shall have holes at the bottom, allowing escaping gasoline to drain away instead of collecting. The Department of Commerce also requires that a fireproof wall separate the motor compartment and the pilot's cockpit to prevent the spread of flames. Chemical extinguisher systems, carried on a number of mail and transport ships, permit the pilot to flood the engine compartment by simply kicking in a plunger located beside his foot in the cockpit.

IN NEWSPAPER accounts, you frequently hear of gasoline tanks "exploding in mid-air." In eighteen years of flying, I have never seen this happen. Gasoline won't burn unless mixed with air. There have been instances where leaking gasoline caught fire and burned right up to the hole in the tank without igniting the inflammable fluid within. The most remarkable case of this kind occurred south of Ypres, Belgium, in 1917.

During a hot dog-fight over our lines, a German bullet crashed into the gas tank of an FE2 pusher with a Rolls-Royce motor. Fuel, spouting from the hole, sprayed over the hot engine, caught fire, and sent flames and smoke streaming to the rear like a giant blowtorch. Instead of going down, the pilot, Sergeant Mottershead, turned on the German plane and chased it all over the sky.

Miles away, as I flew toward the battle, I could see the trail of black smoke circling and crisscrossing as he looped and dove. For nearly ten minutes, this flying bulldog battled on. When I arrived, his spectacular sky-writing had ended. He was going down, plunging like a comet. Even after he landed, the gas tank did not explode, although he was so severely burned he died soon after. His tenacity earned him the Victoria Cross.

In fact, a little gasoline mixed with air is often more dangerous than a lot of gasoline in a full tank. The other day, a ship landed at an eastern airport spattered with oil from a leaking engine. Mechanics removed the oil with gasoline-soaked rags while the engine was being repaired. Anxious to try the motor, the owner swung the machine into the wind and cranked the propeller. A backfire ignited the gasoline on the fabric and razed the ship before the flames could be controlled.

THE most curious ground fire on record occurred in Pennsylvania, not long ago. A giant $80,000 de luxe monoplane was receiving its final touches in preparation for its dedication the next day. A mechanic, applying dope to the wing above the fuselage, accidentally knocked over the can. It fell into the cockpit where an electrician was checking over the batteries, and landed upside-down upon one of them, one side of the tin can touching one terminal and the other side touching the other terminal. The shower of sparks ignited the highly inflammable dope and the whole machine went up in flames.

Because dope, which is applied to the fabric to protect it and hold it taut, is so inflammable in liquid form, many people think that after it has dried on the wings it still burns like celluloid. Instead, the fabric, when it catches fire, glows rather than bursts into flame, eating its way slowly unless it strikes a place that is gasoline soaked.

In fact, once, during the war, a "flaming onion," the antiaircraft incendiary shell which the Germans began firing into the sky in 1916, landed squarely on the wing of a British monoplane. It ate a hole through the fabric and dropped away without causing further damage.

In making modern aircraft more immune to fire, two of the biggest advances have been the development of oil-burning Diesel engines for airplanes and the use of metal in construction. It was the fact that I had motors surrounded by (Continued on page 129)

FIGHTING FIRES HIGH IN THE AIR

(Continued from page 128)

metal instead of wood that probably saved my life in my most spectacular battle with flames in the sky.

Late on the afternoon of August 1, 1928, with two companions, I hopped off from the Azores in a twin-motored Dornier flying boat to cross the Atlantic from east to west.

In the darkness, we smashed through line-squalls that seemed like solid sheets of water; battled high winds and flew blind through four solid hours of fog. A few minutes before midnight, we broke through into clear weather 680 miles from shore.

The backer of the flight, Elwood Hosmer, was in the rear cabin. Fred Pierce, the mechanic, was standing beside me in the cockpit at the far nose of the boat, checking the instruments. Suddenly, he disappeared. An instant later, a red glare reflected on the windshield in front of me.

A fuel pipe in the rear motor nacelle had broken, flooding gasoline over a hot exhaust. The mechanic got back in time to cut off the flow through the broken pipe. Then the flames ate through the duralumin end of the nacelle. A solid sheet of livid flame streamed back thirty feet, beyond the tail.

I dove for the rolling waves, 1,500 feet below. The giant boat dropped like a pursuit ship. When I saw the white crests of the tossing water, turned pink from the glare of the flames, I leveled off. We hit at eighty-five miles an hour, plowed miraculously through the breaking seas and came to a stop.

Pierce was shooting chemicals from our single extinguisher into the nacelle, with Hosmer standing by. When the extinguisher was empty, the flames were still shooting skyward, lighting a grim circle of tumbling black water around us. Below, in the hold of the boat, were fifteen big fuel tanks holding 800 gallons of gasoline. I remember hanging on a strut with my feet in the water, wondering if the flames would eat out to me, forcing me to jump into the water, or if the tanks would let go and blow me in. I preferred the latter; it was quicker.

WHILE we waited, the seconds dragging out into years, the fire began to die down. The chemicals choked off the oxygen. After fifteen minutes, the last flame sputtered and went out. Seasick from the plunging of the boat and the smell of burned duralumin, it took us two hours to rig up our radio and send out an S. O. S. Six ships answered. But the nearest was 150 miles away.

When it arrived at the spot from which we broadcast our call for help, we had drifted fifty miles to the eastward. The blue water of the Gulf Stream was carrying us at two miles an hour and the wind at three or four. In the twenty hours we were afloat, we drifted about a hundred miles. Finally, the *Minnewaska* sighted us. Its captain had taken the 1925 Schneider Cup racers to America and knew something about seaplanes. He allowed for extra wind drift and found us.

In the three years that have passed since that adventure, great strides have been made toward the completely fireproof plane. The better designing of exhausts, drains in cowlings, emergency gas cutoffs, fire-resisting motor compartment walls, vibration-proof fuel lines, chemical extinguisher systems that cut off fires before they can get started and the air maze, which strangles the menace of backfires, have already cut the chances of fire in the air to less than one to a million.

All-metal construction and the further perfection of oil-burning aircraft engines will carry these odds still further toward the vanishing point. Before long, the days when fire rode the skyways will be but a memory.

SECRETS OF SEX EXPLAINED

(Continued from page 40)

means. In most experiments, unfertilized starfish eggs are used. They are immersed, for a few moments, in a weak solution of a substance known as butyric acid. Then they are returned to sea water and allowed to develop. The mechanical method is even simpler. Puncturing an unfertilized frog's egg with a needle will cause it to hatch almost immediately.

MR. MOK: I can readily see how these experiments might show that the chromosomes carry physical characteristics. But how do you know that they also transmit mental traits?

DR. RUCKES: We don't exactly know it, but we have every reason to assume it. There is not such a great difference between physical and mental characteristics as most people believe. As I see it, a mental trait is merely an expression of a physical function.

MR. MOK: Is that why you assume that chromosomes carry mental traits?

DR. RUCKES: Not exactly. Let me explain. I need not tell you that it is quite usual for a son to act like his father and to have several of his mental quirks.

MR. MOK: Yes, but isn't much of this due to imitation and training?

DR. RUCKES: Some of it may be, but most of it is inherited. This is shown by the fact that a child often resembles, mentally as well as physically, its grandparents or great-grandparents it has never seen. Obviously, it is logical to assume that the same chromosomes which carry, say, the color of the eyes or the shape of the nose from a grandfather to a grandson, also are responsible for the fact that the boy possesses, for example, his grandfather's perseverance.

MR. MOK: I should think you would have a hard time proving that chromosomes carry the color of a grandfather's eyes down to his grandson.

DR. RUCKES: It isn't quite as hard as you think it is, though it is a rather intricate business. Anyway, it has all been proved within the past twenty-five years. But before I tell you how it was proved, let me give you an idea of how we come by our present knowledge of these matters. Up to the nineteenth century, it was commonly believed that the fully formed human or other animal was contained, in miniature, either in the egg or in the sperm.

MR. MOK: You mean a tiny but perfect man or woman?

DR. RUCKES: That, or a tiny but complete male or female animal. This was not just a popular belief, but a scientific theory, known as the doctrine of pre-formation. As a matter of fact, there were two theories of this kind. According to one, the miniature human being or animal was contained in the egg, and only the sperm was needed to stimulate its growth. The other theory had the miniature man or beast in the sperm, and the egg was necessary to enlarge it. Carrying these theories to their logical conclusion, all future generations would have to be encased, like the smaller boxes within the larger ones in the Chinese puzzle, inside the miniature man or animal. And this is not a mere fancy of mine. Along these lines, serious calculations were made to show that within the body of Mother Eve there were contained the miniatures of 200,000,000 descendants, at the exhaustion of which the human race would cease to exist. In 1699, a famous Italian anatomist believed he actually had observed the complete human form in what we now know was the nucleus of a sperm cell.

MR. MOK: A vivid imagination! How long did these queer notions persist?

DR. RUCKES: Until 1827. In that year, the pre-formation theories and all that went with them were overthrown by the famous German scientist von Baer, who conclusively demonstrated the fertilization of the human egg by the sperm and its *subsequent* development. So you see, our knowledge of these things is only a little more than 100 years old.

MR. MOK: But what of the transmission of characteristics?

DR. RUCKES: I am coming to that now. In 1865, the Abbé Mendel, an Augustinian monk working in a monastery at Bruenn, Austria, demonstrated, in a series of experiments, the transmission of characteristics by the reproduction process. For this purpose, Mendel used common garden peas. He crossed a dwarf plant with a tall plant by impregnating the flowers of one with the pollen of the other.

MR. MOK: Did he get a new, medium-sized plant?

DR. RUCKES: This is a logical question to ask, but the answer is "No". The hybrid plants he got were all tall.

MR. MOK: Does this mean that, if a father is tall and a mother short, or vice-versa, their children are always tall?

DR. RUCKES: Not necessarily. In man, stature is determined only partly by inheritance and partly by the glands of internal secretion, about which I will tell you another time.

MR. MOK: What did Mendel's experiment prove, then?

DR. RUCKES: It did not prove anything until he crossed his tall hybrids with one another. Now, a certain number of the resulting offspring were dwarf, while others were tall.

MR. MOK: Wasn't that, perhaps, just chance?

DR. RUCKES: Not at all. Mendel repeated this experiment four times and found it worked out with mathematical accuracy and certainty. In computing the number of offspring, he discovered that there were always three times as many tall plants in the second generation as there were short or dwarf plants. This is now generally known as the three-to-one Mendelian ratio.

MR. MOK: Why was it that, when the first generation of hybrids was all tall, the offspring in the second generation were tall and short in the proportion of three to one?

DR. RUCKES: Mendel concluded that this was due to the fact that the characteristic of shortness involved in this cross lay dormant in the first generation of hybrids, but did not disappear. In other words, while these plants were tall, they still retained the ability to hand down shortness, and this is exactly what happened in each of the four experiments. Mendel called the characteristics that were dormant in the first generation the *recessive* ones, and those that were apparent, the *dominant* ones.

MR. MOK: Then tallness in Mendel's garden peas was dominant, and shortness recessive?

DR. RUCKES: Right.

MR. MOK: Is tallness always dominant in all plants and animals, or does it apply only to garden peas?

DR. RUCKES: Mendel established it definitely in the case of garden peas, but it need not necessarily be true of other living things. It often is, but not always.

MR. MOK: If it was established definitely only in the case *(Continued on page 131)*

SECRETS OF SEX EXPLAINED

(Continued from page 130)

of garden peas, I should imagine that Mendel's experiments were valuable only to pea growers.

DR. RUCKES: By no means. Other investigators later demonstrated that the same ratio holds true in many other plants and animals, including man, and in the cases of other characteristics beside tallness and shortness. For instance: A man with blue eyes marries a girl who also has blue eyes. The children will all be blue-eyed. When you wed these children to blue-eyed children of blue-eyed parents, you again will get blue-eyed offspring. If the same matings are made with brown-eyed people of pure brown-eyed stock, the result also will be brown-eyed children. *However, if a brown-eyed person of pure brown-eyed stock marries a blue-eyed person of pure blue-eyed stock, the children will all have brown eyes, just as Mendel's first generation of hybrids were all tall pea plants.*

MR. MOK: Why?

DR. RUCKES: Because brown eyes are dominant over blue eyes, just as tallness is dominant over shortness in peas.

MR. MOK: How about the second generation in people?

DR. RUCKES: In order to carry out the analogy with the Mendel experiment, we must now assume that all these brown-eyed children marry brown-eyed people of similar brown-and-blue-eyed hybrid parentage. The children from these marriages will be brown-eyed and blue-eyed in the ratio of three brown to one blue, provided, of course, that enough children are born to make the calculation.

MR. MOK: My parents are both brown-eyed. My eyes are brown, too. But my sister's are blue. How do you explain that?

DR. RUCKES: Your parents undoubtedly are of the hybrid stock I have just described. Therefore, they both carried the blue recessive characteristic, just as Mendel's first generation of tall hybrid plants carried recessive shortness. In the case of your sister, the two recessive characteristics have united to produce blue eyes. In your own case, the dominant brown asserted itself so that you may be a pure dominant brown or a hybrid brown-and-blue. May I ask you a personal question?

MR. MOK: Certainly.

DR. RUCKES: Do you have children who are blue-eyed?

MR. MOK: I have.

DR. RUCKES: Then you obviously are a hybrid and not a pure brown-eyed person. Is this clear?

MR. MOK: Yes, but it is a pretty complicated business.

DR. RUCKES: Complicated? Nothing! We are merely talking about one characteristic—the color of the eyes. Just imagine how really involved it becomes when one begins to deal with the tens of thousands of characteristics each one of us carries around with him and hands on to his offspring.

MR. MOK: Did Mendel discover the chromosomes?

DR. RUCKES: No. While Mendel's work was done prior to 1865, chromosomes were not discovered until 1872 by the German biologist Flemming. This discovery has been responsible for countless barrels of burned midnight oil, plenty of brain-fag, flunked examinations and the resultant heartaches.

MR. MOK: Why has it?

DR. RUCKES: Because the system for which he laid the foundation is so involved and so difficult to understand that it is rivaled only by higher mathematics. However, all of us can grasp the (Continued on page 132)

SECRETS OF SEX EXPLAINED

(Continued from page 131)

fundamentals of it without much study.

MR. MOK: What are they?

DR. RUCKES: The nucleus of each of the billions of cells that make up our bodies contains the same kind of machinery that is contained in the reproductive cells.

MR. MOK: You mean that the cells of my muscles, eyes, skin, and brain also have chromosomes?

DR. RUCKES: Yes, almost all of them do. *In a man, all of the body cells, except the sperm cells, contain 47 chromosomes. In a woman, all the body cells have 48 chromosomes, except the egg cells.*

MR. MOK: How many do the egg cells and the sperm cells have?

DR. RUCKES: *A human egg cell has 24 chromosomes. But the sperm cells each man produces are of two kinds—half of them have 23 chromosomes and half have 24. Obviously, the egg cell and the sperm cell each carries half of the total number for the purpose of re-establishing the total when united. When this union takes place, you have a fertilized egg cell containing either 47 or 48 chromosomes—in other words, a future boy or girl.* The fact that there is a difference of one in the number of male and female chromosomes was established only very recently by Dr. Theophilus S. Painter, professor of zoölogy in the University of Texas.

MR. MOK: If I understand your explanation correctly, the sex of a child depends on the particular kind of sperm cell that happens to be united with the egg cell.

DR. RUCKES: Quite so; that is, in human beings and all animals except birds, butterflies, and moths. In those cases, the sex of the offspring is determined by the mother.

MR. MOK: How does it happen that, in some cases, a sperm cell with 23 chromosomes operates, producing a boy, and in other cases a sperm cell with 24 chromosomes, producing a girl?

DR. RUCKES: *This happens purely by chance.* You must realize that, prior to each conception, thousands of sperm cells are produced, and only one of them causes fertilization—the one that unites with the egg cell first. Since two kinds of sperm cells are produced and about an equal number of each kind, the chances are approximately 50-50. For that reason, there are about an equal number of men and women in the world. It is true that there are slightly more women, but that is due to other causes, mainly higher infant mortality among boys.

MR. MOK: To come back to inheritance—are our characteristics handed down to us by means of these 24 egg cell chromosomes and the 23 or 24 sperm cell chromosomes?

DR. RUCKES: Precisely. To understand how marvelous this operation really is, you must know that each of the 47 or 48 chromosomes in every single one of the billions of cells in our bodies carries several hundred characteristics, so that the total number of characteristics in each cell nucleus reaches way up into the thousands. In other words, practically all the characteristics that go to make up our entire personality are condensed in each of these tiny cell nuclei, no matter in what part of the body they may be found. Don't forget that we develop through the division and subdivision of one fertilized egg cell.

MR. MOK: How is it possible that all these thousands of characteristics are carried by these 24 mother chromosomes and the 23 or 24 father chromosomes that are responsible for the new individual?

DR. RUCKES: Each characteristic is represented in the egg and sperm chromosomes by ultramicroscopic units known as *genes*. That is why the study of this subject is called the science of genetics.

MR. MOK: Has anyone ever seen a gene?

DR. RUCKES: No, they are hypothetical units, supposed to be submicroscopic chemical particles.

MR. MOK: Will we ever be able to know in advance whether a child will be a boy or a girl?

DR. RUCKES: So far as we know now, we will not. As I said before, it is a matter of pure chance. There are plenty of quacks who pretend to know how the sex of children can be pre-determined, and who defraud married people by selling them knowledge which neither they nor anyone else possesses. They are fakers. However, once an unborn baby is well on its way toward development, about the fifth month, its sex can be ascertained in various scientific ways. First, it may be told by the heartbeat of the embryo; that of a girl is faster. But this method is not entirely conclusive. A better and more certain way is by means of X-rays, which reveal the rate of the bone formation. At a certain stage, the bones of a girl, which develop faster than those of a boy, are about a week ahead.

MR. MOK: What causes twins?

DR. RUCKES: As you probably know, there are two kinds of twins—so-called common twins and identical twins. Common twins occur when two eggs are fertilized by two sperms. Then you simply get two children that happen to be born at the same time. They may be brothers, or sisters, or a brother and a sister. But identical twins are always of the same sex and are almost identical in appearance.

MR. MOK: Why is this?

DR. RUCKES: Because identical twins are the products of a single fertilized egg cell which, at its first cell division, separated into two free cells that did not remain attached to one another.

MR. MOK: Why does this cause them to be of the same sex and to have the same characteristics?

DR. RUCKES: As I have told you, all characteristics, including sex, are determined by the chromosomes in the egg cell and the sperm cell. Identical twins are the product of the union of only one set of paternal and one set of maternal chromosomes.

MR. MOK: Do twins run in families?

DR. RUCKES: Many people seem to believe that, but I do not think twinning is inheritable. Now, from all that I have told you, you must not get the idea that this matter of our individual characteristics is solely determined by inheritance.

MR. MOK: What else enters into it?

DR. RUCKES: Chemical action. The latest studies in this field have shown that many of our characteristics, including our emotional peculiarities, are determined by chemical regulators produced by the glands of internal secretion, or endocrine glands. That, for example, is the reason that parents of normal stature may have a giant or a midget child. But I will tell you about that in our next talk.

WHAT is a dwarf? What is a giant? Why the "fat lady" of the circus? Why do dispositions differ? Why are some people quick-tempered and others patient and serene? What is meant by the "vigor of youth?" Once lost, can it be regained? What is a so-called "monkey-gland operation" and what benefit does the patient derive from it? The answers to these questions will be given by Dr. Ruckes in the December POPULAR SCIENCE MONTHLY, *out November 2.*

FREAK ACCIDENTS

(Continued from page 43)

place else. A man can expect to ride—if his riding career isn't cut short by old age!—a half billion miles in street cars before he experiences a fatal accident. He is justified in looking forward to 270,000,000 miles of rail travel before he loses his life in a railroad accident. He even can expect to travel almost 21,000,000 miles as a passenger in automobiles before becoming the victim of a fatal mischance. As a passenger in transport planes flying over scheduled routes, he can look forward to a million and a half miles of flying before the last crash.

Many an air-minded traveler has flown thousands of miles in transport planes without being inconvenienced by even a trivial accident. That wasn't the luck of David L. Jones, a Londoner. One day he took a "jitney hop." The plane crashed, but he wasn't injured. Undismayed, he tried again. Again the plane crashed, and again he escaped injury. A little later he was in Berlin, and in a hurry to get back to London.

It seemed to him that he must have had his share of bad air luck, so he boarded one of the big Lufthansa air liners. Somewhere over the south of England the German ship ran into a heavy fog, and crashed on a hillside. Jones was one of the six who were killed.

ACCIDENTS lead to hospitals, and most people are anxious to keep out of hospitals as much as is possible—but they feel safe while they are in one. Yet even in hospitals unexpected dangers lie waiting.

Mrs. Maude Branton, of Los Angeles, was on a hospital operating table when she was killed by an explosion of anesthetic gas in her lungs. The surgeons suggested that the explosion was caused by a spark of static electricity—perhaps from the operating surgeon's hand, perhaps from the metal cone used in giving the anesthetic.

Another out-of-the-ordinary hospital accident happened when a doctor, watching an anesthetic being administered, was overcome by the fumes, fell, and fractured his skull on the concrete floor of the operating room.

"Safe at home" is an expression that sounds well—but one that ceases to mean anything much when you study accident statistics. Each year about 30,000 Americans are killed by accidents in their homes, many more than are killed in industrial accidents, and it is estimated that there are 4,500,000 nonfatal home accidents annually. Falls, cuts, burns, scalds, and asphyxiation are the most common home dangers.

Apparently one of the most dangerous things that anyone can do is to take a bath. It is calculated that when you step into your bathtub you are running a thousand times more risk of injury than you do when you board a train for a railroad journey, and two hundred times more risk of accident than you do when you climb into a licensed airplane.

IN FACT, the bathing hazard has become so formidable that an accident prevention expert recently suggested that all bathtubs be made with flat bottoms, and that they be equipped with handrails.

Falls, of course, are responsible for most home bathing injuries, but electrical appliances close to bathtubs have caused many terrible and fatal accidents. Not long ago a man standing in his tub happened to touch a water pipe, which had been charged with electricity by contact with some piece of home electrical apparatus. The shock that the bather received startled him so badly that he jumped, lost his footing in the slippery tub, and fell out of an open window!

Under normal (Continued on page 134)

FREAK ACCIDENTS

(Continued from page 133)

conditions the low voltages used for house lighting are not dangerous, but when the skin is wet, as when bathing or even when a person is perspiring freely, or there are cuts or bruises on the skin that touches the electric wire, even low voltages sometimes affect the heart action sufficiently to cause death. For this reason, some safety experts say that portable electrical appliances, such as heaters and curling irons, never should be used in bathrooms.

Often a person steps out of danger into what seems to be safety, only to find unexpected danger still awaiting him. That's what happened to Jack Armstrong, a first-string tackle on last fall's United States Military Academy football team. Armstrong went through a tough season without injury. Relieved, he celebrated, the day after its close, by going skating. Colliding with another Cadet skater, he had his nose broken!

Then there is Dale Riggs, of Mesa, Colo., who played football for several years without injury, and then, while dressing for practice, fell and broke his collar bone.

GOLF, which at first glance seems a mild and safe game, is the cause of many accidents. One of the most unusual of them happened when a business man golfer swung, missed the ball, hit the root of a tree solidly with his club-head—and lost the sight of one of his eyes! Although he didn't know it, he was a victim of a not-uncommon eye disease in which any severe jar is likely to result in blindness. Several persons lost their sight when well-meaning friends slapped them heartily on the back.

Cadet James Glattly, a member of the Army track team, was the victim of another unusual sport accident last spring. While he was running at top speed he ran into an inaccurately-thrown javelin that had struck the ground in front of him. The butt of the javelin entered his mouth, and he suffered a concussion of the brain.

One of many accidents never fully explained was the misfortune of a New York man who, while walking along the street, was struck on the head by a heavy hammer that seemed to come out of the blue sky. Careful investigation resulted in only one logical inference, that some ironworker on a tall building under construction a full half block away had thrown the tool to a mate and that the mate had missed catching it. There are rules against throwing tools on construction jobs, but you can't expect ironworkers to be too careful of pedestrians, when they aren't careful of themselves, as the craft's premium rate of $459 per thousand of insurance proves.

Sometimes the cause of an accident is another accident. That was the case when a barn in Evanston, Ill., was destroyed by fire. It happened this way:

A MILK-TRUCK driver stopped at a gas station to fill his tank. While he was doing it, he got the tails of his white canvas coat wet with gasoline. About to climb to his seat, he flicked the ashes off his cigarette. They fell on his coat tails and set the coat afire. The startled driver pulled the coat off and threw it away from him. The blazing coat landed on the tail of a horse standing near by. The outraged horse switched its tail, throwing the flaming coat onto a pile of hay. And the burning hay set the barn on fire!

Motor vehicles cause one third of the accident fatalities in the United States. Last year there were 330,000 automobile accidents, involving a million people, resulting in 33,000 deaths, and causing an economic loss of $900,000,000.

In the last eighteen months more people were killed in automobile accidents in the United States than American soldiers were killed in action or died of wounds in the World War!

Since 1926 deaths caused by automobiles have increased even more rapidly than automobiles have increased. This increase in the automobile death rate is caused by private cars, as the commercial-vehicle rate shows a decline.

Most automobile fatalities are caused by motor vehicles running down pedestrians. A study covering a population of 62,000,000, three quarters of it living in cities of 100,000 or more, shows that in slightly less than 14,000 automobile fatalities, over 6,000 of the victims were pedestrians. Collisions between automobiles caused over 2,500 deaths. Accidents in which there was no collision killed 1,500 people. Over 1,000 were killed in accidents in which an automobile crashed into a fixed object that seemed to be in plain view.

One of the oddest of this latter class of accidents was caused by a motorist driving head-on into a house that had been left overnight in the middle of a city street!

The house was being moved. When its slow progress was stopped by darkness, it was left in the street. There was normal street lighting, the customary warning lights were displayed, and the house was full in the glare of the headlights of approaching cars. In spite of all this, an automobile traveling at high speed crashed into the house—or, rather, into some of its temporary supports—and came to a stop, a shattered wreck, under it. All three of the people in the car were killed.

IN ENGLAND a motorcyclist, speeding at night along a quiet country road, was injured when he collided with an elephant.

A few weeks ago a Michigan man stopped his automobile and turned to speak to his four small daughters who were riding in the rear seat. All four were unconscious. A sharp stone had cut a hole in the exhaust pipe permitting carbon monoxide gas to pour into the closed car through the floor boards. The deadly fumes had not affected the father because the front windows of the car were open.

To some people unexpected dangers come while they are doing things in themselves dangerous, to others they come while they are doing things that seem to have about them no slightest element of danger.

There was, for example, the chap who, on his return after a short absence, went to call on his best girl. She proved that she was glad to see him by hugging him so hard that she broke three of his ribs and sent him to a doctor for costly repairs.

Then there was the fellow who held his girl on his lap so long that one of his legs "went to sleep." When he got up the numb limb gave way beneath his weight, and he fell and bruised himself so seriously that an insurance company had a claim to pay.

WHILE still another swain was dancing with a woman friend, a pin in her hair pierced his right ear drum, inflicting a painful wound and causing deafness!

Yes, it is the danger that is the least expected that soonest comes to us. Many queer accidents have proved the truth of that saying, but none of them has proved it more convincingly than the strange experience of James Murray, of New Rochelle, N. Y., who was painfully injured by being struck on the head by a good-luck horseshoe that he had fastened over his doorway!

EXPLORING NEW YORK'S REAL UNDERWORLD

(Continued from page 21)

Should one sub-station be put out of commission, its work could be taken over by neighboring stations. Even if all four generating plants were rendered inoperative simultaneously, the sub-stations could for a time supply current from their own independent dynamos and from giant storage batteries kept constantly charged.

PRACTICALLY every inch of cable and wire in this huge transmission and distributing system is carried underground through ducts owned by a private corporation and rented to the utility companies. Access to these ducts is obtained through manholes at the street corners, new cable being drawn in at one end of the block as old cable is drawn out at the other end.

If electricity were the only commodity that the streets had to accommodate, and if adequate conduits had been built at the time the streets were laid out, the installation and maintenance of such a system might not be particularly complicated. But most of the streets were laid out before underground installation became essential. In those days Manhattan was not honeycombed as it is now and men could dig and blast trenches in its surface more or less with impunity. The population being relatively small, there was plenty of room both below and above ground.

In the late nineties, telephone wires were still carried on poles. Today, all but a small percentage of them in Manhattan are underground.

There is plenty of it, as you can imagine, on realizing that New York City uses 1,800,000 telephones, exclusive of 25,000 private line phones. This is more than one and one half times the total used in France, more than three times the total in South America, and more than nine tenths of the number in the British Isles.

The average daily traffic originating in the city's telephones in 1930 was 8,181,117 calls, an average of ninety-five each second. To handle this huge volume of talk there are in New York City 9,400,000 miles of exchange and toll wire, which would stretch approximately 376 times around the world, enough to string thirty-nine wires from the earth to the moon.

THAT is a lot of wire, and only ceaseless research in the field of cable development has made it possible to compress it into the scant space available beneath the New York streets. One cable now in use, developed only four years ago, contains, within a sheath only two and five-eighths inches in diameter, 3,636 individual wires.

To support the contents of just one such cable overhead, as in the old days, would require thirteen poles, each with twenty-eight cross arms, each cross arm carrying ten wires.

Just as the geographical location of Manhattan has forced its development skyward, so has its long narrow shape compelled its modern rapid transit lines to take an underground course. The surface cars, buses, and elevated railroads can carry but a fraction of the throngs who daily and nightly must be transported to and from their homes.

In the district known as the Grand Central zone, an area several blocks square, centering around Forty-second Street and Park Avenue, the city can best be described as a rabbit warren. Here is the terminus of two great railroads and, radiating from it in all directions, are underground corridors and tunnels, lined with stores and restaurants and leading to scores of business buildings and hotels. In this *(Continued on page 136)*

EXPLORING NEW YORK'S REAL UNDERWORLD

(Continued from page 135)

region a man could, if he wished, live all his life without ever needing to emerge upon the street.

To the north of Grand Central Terminal, beneath Park Avenue and its great hotels and apartment houses and office buildings, are two huge railroad yards, one below the other, with the trackage, sidings, and signal systems necessary for the handling of hundreds of outgoing and incoming trains daily.

Under the south and east limits of the big station, a crosstown shuttle subway connects with a north and south subway line, while deep below that is still another totally different subway system linking Manhattan, by means of tubes below the East River, with the Borough of Queens.

Due south of the terminal, a ramp for vehicles forms a bridge over Forty-second Street, and a surface-car line changes its status by running through a half-mile tunnel under old Murray Hill. Thus, at one point, there are four traffic levels: an elevated roadway, the street itself, a subway and another subway under that.

WHEN the mileage now under construction is completed, the city will have approximately 1,075 running track miles (exclusive of yard and siding trackage) of subways—more than the distance between New York and Chicago. Meanwhile existing routes, cables, ducts, and mains make construction more and more difficult and expensive. It is estimated, for instance, that the one hundred miles of new routes included in the current projects will cost $438,400,000, which works out at the rate of nearly $4,400,000 per mile.

One of the new subways is to run under Sixth Avenue, on which thoroughfare there are already an elevated railroad and a surface car line. To build the subway, without weakening the elevated structure, required the underpinning of the steel columns supporting that road. This means that, while trains pass over it day and night, the elevated's columns must be jacked up, their bases removed, and new, stronger ones substituted—a little item that will cost an extra, unexpected $5,000,000.

Last May it was announced that another difficulty had cropped up which necessitated postponing work on this particular line for two years. Under Sixth Avenue is buried a great aqueduct, bringing water from upstate reservoirs to the people of Brooklyn, Queens, and Staten Island at the rate of 200,000,000 gallons a day. The possibility that blasting for the projected subway might damage this main, jeopardizing the water supply of three other boroughs, seemed too great to justify the risk.

THEREFORE the $40,000,000 subway link is being delayed, pending completion of a new aqueduct now being built, a seventeen-foot tunnel that will pass from the Bronx to Brooklyn, under the Harlem and East Rivers, without touching Manhattan Island at all.

Carrying on these projects, alongside of a multiplicity of existing underground services, with a minimum of interruption to the latter, keeps everybody concerned on his toes. Nor is it the underground structure alone that must be disturbed as little as possible. Because of traffic congestion, the streets and sidewalks must be kept in use at all costs.

There are two methods of building subways. The first, used where the tunnel is to run fairly close to the surface, is known as the "cut-and-cover" method. This consists in cutting a trench and then covering it, so that the cover *(Continued on page 137)*

NEW YORK'S REAL UNDERWORLD

(Continued from page 136)

can be used as a roadway. Frequently the excavating is done only at night, when rerouting of traffic will create no serious jams. In itself, the operation is simple enough. It is the avoidance of the vital networks that complicates the work.

A few years ago, during construction of one cut-and-cover subway, a series of fires broke out under the wooden decking, putting out of commission light and power lines, telephone cables, and fire and police alarm systems. The tangle of damaged cables resembled a cave full of giant spaghetti. Some 35,000 pairs of telephone wires alone were affected, their leaden sheaths and metal identification tags melted off, their paper insulation destroyed by fire and water.

A GLIMPSE into a subway cut reveals these buried nerves and arteries which, during construction operations, have to be guyed up or placed in temporary ducts. Looking at the conglomeration that lies beneath a Manhattan street, one can readily understand why nobody is allowed to dig even a tiny hole without an official permit.

Engineers in various city departments and public utility companies have access to maps on which the course of every pipe, tunnel, sewer, or wire is charted. Even so, accredited workmen at times cause plenty of trouble by unwittingly driving drills or pneumatic hammers into gas or water mains.

The latter, forty-eight inches in diameter, have an incalculable potentiality for causing grief; not only because of the geysers of water they spout when broken, but because of the havoc this water can wreak on other service systems. The greatest damage to electric cables is caused by water. Even a pin-prick in a cable-sheathing will admit moisture enough to cause a short circuit.

The latest method of checking up on the condition of telephone cables is to force nitrogen into them. When a tiny break occurs, the resulting leak of gas is indicated on pressure gages. Into some of the newest types of high-tension power cables, oil is pumped, so that in the event of a break in the insulation the oil will keep out water until repairs can be made.

In addition to the regular water mains, handling the city's normal requirement of 900,000,000 gallons a day, there is, in lower Manhattan, a high pressure system installed for fire-fighting purposes in the district of tall buildings. A special pumping station supplies this system, being capable of furnishing water at pressures up to 300 pounds. The effects of an accidental break in one of the mains of this high pressure waterworks can easily be imagined.

THE second method of subway building, employed for deep tunnels under the city and under the rivers, is a boring operation. Sandhogs, working under compressed air, clear the way for huge steel shields with circular cutting edges, which are shoved ahead by means of hydraulic jacks. With such jobs, interference with shallow-laid services is not often a factor.

The possibilities of damage, deep down, lie in the effects that blasting may have on the foundations of skyscrapers. These often have to be reënforced, sometimes entirely rebuilt, to stand not only the extra stresses and shocks imposed by adjacent tunnel building, but to offset the vibration to be caused by future train service. Some great buildings are mounted on oil-filled shock absorbers to protect them from such vibration.

Though the menace to networks of wire and pipe are not very great in the boring of deep subways, there is considerable danger to the workmen from cave-ins, rock slides, and unexpected pockets of sand or quicksand. The rock of Manhattan is veined with innumerable subterranean springs and streams, some of which defy all efforts of engineers to dam them up.

In certain parts of the subways, in steam conduits and other ducts, automatic ejectors are constantly in service, discharging this unwanted water into the sewers. When the telephone company's headquarters building in New York was erected, the builders, unable to dam a natural spring beneath it, incorporated a cistern into the basement. Incidentally, the water accumulating there, being very pure, is sold by the company to neighborhood produce dealers for drinking purposes.

In one respect only, underground Manhattan has been adequately equipped from its early days; namely, in the matter of sewers, of which there are upwards of six hundred miles in the city. In spite of the tremendous volume of waste water—nearly 150 gallons per inhabitant per day—that the sewage system must carry off in addition to the rainfall, serious sewer trouble is virtually unknown.

EVEN the concentration of huge units of population into small areas, with a resultant concentration of wastes, has not overloaded the generously planned old-time sewers. For the most part they are brick tunnels, from eight to sixteen feet in diameter, that empty themselves by gravity into the surrounding rivers. A large force of men is kept constantly at work, keeping these tunnels and the catch basins draining into them free from obstructions.

Sewer explosions that hurled heavy iron manhole covers through the air were quite frequent at one period of the city's history. This was in the early days of automobiles, when waste gasoline and oil found their way into the sewage system, there to form highly combustible gases. Since city ordinances were established requiring all garage and cleaning concerns to install apparatus for separating gasoline and oil from their wastes, this hazard has been almost entirely eliminated.

AMONG the varied wonders of underground Manhattan are the great bank vaults, storage places for billions in gold and currency. Some of these caverns, hewn in the bedrock of the island, are five or more stories below the level of the streets. These treasure chambers may be said to be absolutely impregnable.

They are guarded from above by trained forces armed with every weapon from machine guns to gas bombs. Underground walls and floors, interlaid with armor plate, together with sensitive alarm signals, are effective barriers to marauders who might aim to bore their way in. Encircling corridors, brilliantly lighted, are equipped with mirrors at every turn, enabling the guards to see even around corners.

Miles of pneumatic tubes, whizzing mail in brass cylinders between branch post offices; brewery tunnels, now abandoned but formerly used for storing lager beer; secret passages, now bricked-up, that were a feature of Old Chinatown; ancient wooden water mains of New Amsterdam, occasionally unearthed today; buried streets and cemeteries, whose existence has long been forgotten; even relics of those Indian tribes who sold the island for $24—all these and more add to the fascination of peering beneath Manhattan's skin.

CANNING NOISES FOR THE TALKIES

(Continued from page 55)

inaudible to anyone walking one hundred feet away, yet when the sound men finished their jobs the beautiful deep gurgle of the small stream and the splash of the waterfall sounded at various places along the film like tiny streams and ocean waves. By moving the microphone as close to the fall as he could without splashing the diaphragm, he intensified the noises.

Of course, footsteps play an important part in pictures. The tapping of soft-clad toes on a ballroom floor, on concrete, wood, carpet, gravel, and on rain-soaked ground offer no problems of recording. So with footsteps in brush. Brown set up the equipment and for half a day walked around the mike, now with measured tread, again swiftly, making a record of his own footfalls.

USUALLY the microphone is pointed directly toward the source of sound, but occasionally it must be kept at a safe distance from the noises, such as clashing sabers, to avoid over-recording. When recording such sharp metallic sounds the mike usually is turned slightly away from the direct path of the sound. Noises of this type, including the click or pound of solid objects, usually are made within the studios. Recently four actors spent a half-day tinkling ice in glasses and setting down glasses with varying amounts of liquid on a table with only a microphone present.

Animal sounds offer more problems, however, for two reasons: Many animal sounds are used and the animals sometimes balk at being recorded.

A recent picture was filmed in Africa, but the native songs and chants and the mournful howlings of the animals were added in Hollywood. There is no faking about this. Most movie men will admit these animal pictures are "shot silent" with the sound added later.

The animals that growled and purred for this adventurous picture live at their ease in zoos near Los Angeles. Even such strange animals as the water buffalo performed for Madame Olga at Selig Zoo. She has raised many of these beasts from babes and by teasing and leading them, she can coax sounds for the mike.

Usually, explained Brown, animal noises are canned early in the morning and at sunset. "These seem to be their happiest times," he said. "Animals then are playful and natural and will work for the mike more easily than at midday."

Brown directed the noise recording of 200 types of birds and animals for the African series. Two crews worked two months. Tame tigers roared and even sound for a fight between a lion and hyena was recorded at Selig Zoo.

HERE the sound crew moved in on the hyena just before feeding time at night. Madame Olga held a piece of meat just outside his reach. Then, as the animal was teased, he emitted those terrible, hysterical laughs that silence all the other animals in the zoo. The lion's growls were similarly recorded.

The hyena will fight a lion over food, and when denied his dinner, even in a zoo, his demands are voiced in unpleasant music. The sound department, after recording his laughs, has only half-completed its job. It must fit the hyena's laugh with the lion's roar on the sound track alongside the picture showing a lion and hyena fighting over an African deer. They are "mixed," and in the theater you'd never know the noises came from a western zoo.

Many sounds cannot be recorded within the walls of sound stage or arena. Occasionally a crew sets out at midnight to find an elusive mocking bird, which never would sing were human hands or a cage to bring it to the microphone. Here Mohammed goes to the mountain.

"In making animal sounds," Brown said, "we eventually get what we want. Not long ago we needed the 'baa's' of a nanny-goat and her babe. We tried several tricks while they were together in the corner of a field, but everything failed. Finally I decided to steal the young one, and as soon as the pair were separated, the babe cried piteously into the microphone. When we returned to the mother we found her in spasms. Then the reunion. Such bleating and baaing you never heard. Marvelous! Now they're in the can.

"At midnight a few nights later we started out in five cars to find a mocking bird. The first one, located in the San Fernando valley, sang; but she was a beginner and knew no pretty songs.

"THE second one sang well, but the distant night traffic came in so strong we couldn't use her. We continued from address to address, sent in to the studio by friends, until near the police station in south Hollywood, at 3 A. M., we found a mocking bird with a repertoire of twelve songs.

"We sneaked into the back yard of the home and set up the mike twenty feet from the bird. Unaware that she was performing, the bird sang her songs five times as we recorded 2,000 feet of sound track. At four o'clock, when the roosters began to crow, the little creature stopped, just as though we had paid the artist for one hour's performance.

"Bird songs probably are the most difficult sounds to record because of the high frequencies. We experimented a year before we were able to reproduce them naturally. When I stand under a tree listening, it sounds as though a bird maintains the same level of sound, but occasionally it lets out a peep both louder and of higher frequency. That inaudible change causes all the trouble.

"We use special electrical filters to hold those high notes down. Formerly, when we recorded on wax, the low notes bothered us; on the film, sound is transformed into light and the silver strings of the little light valve, which are placed one half millimeter apart, vibrate so violently that they touch when high notes come through. When this happens a clash, loud enough to be recorded and interfere with the song, occurs. These valves are so fine we can record breathing. For that reason we must cut down the power input with a pad, a rheostat which creates resistance, to avoid frequencies above 5,000 cycles."

Pads or no pads, however, the sound crew could not make five owls hoot when they were loosed on a darkened sound stage several weeks later. That was, in his opinion, the most difficult recording of birds Brown has attempted. The owls were expected to hoot as soon as lights were doused, but their silence became golden as expenses piled up.

CHAIRS had been arranged in a circle around the microphone; the owls, it was anticipated, would perch on their chair backs and hoot in the darkness. After five hours of futile chasing with brooms, while assistants dodged outstretched claws as their gleaming eyes sped through the dark, Brown called for lights and went into a huddle with the trainer. They decided to try coaxing.

"I'll give you *(Continued on page 139)*

CANNING NOISES FOR THE TALKIES

(Continued from page 138)

some fine chicken, if you'll only hoot," said the trainer to his pet owl.

He parceled out a few choice bits among the five, and lights were turned out again. Success! From a single owl twenty-five first-class hoots were recorded for use in some future picture.

Some of the famous animal stars have the same troubles with enunciation that human stars experience. The mike has "killed" more than one formerly prominent actor, but Rin Tin Tin's mother came to his rescue. Nanette has doubled for Rin Tin Tin as she growled and barked and whined into a microphone far from a camera. Jack Leonard, her trainer, speaks a few words to this intelligent animal and she pours her best sounds into the metal ear, thus saving the reputation of her son with the picture fans.

Occasionally the sound canners encounter birds or animals that refuse to coöperate. Not long ago a call came to the sound department at Warner Brothers-First National studios for a group of pheasant and peacock sounds. Brown has a cage of birds at his home in which the pheasants and peacocks had been making so much noise he was expecting the neighbors to complain. But when the sound truck arrived, after the birds had sung constantly for three weeks, he couldn't get a peep from them that was worth recording for the movie studio.

THE most simple recording came when he canned a rattlesnake's rattlings. Some one brought a five-foot rattler to the studio ranch, an assistant tied the snake's head up a few inches from the ground to keep him in a semicoiled rattling position, the mike was placed a few feet from the rattles, and the show began. The assistant teased the snake with a long stick, and the snake rattled, ineffectually but loudly, and the fear-arousing noise was thus caught and permanently recorded for dramatic use.

Two threads tied to the tail and one front foot, when pulled in opposite directions, brought squeals from a mouse. Here the microphone was placed about five feet from the source of the squeals. The picture for which this was made reveals the mouse running, squealing, from a sideshow, and naturally the squeals are surprisingly real.

Not all efforts are devoted to the recording of natural sounds, however. Sometimes these engineers have more difficulty in suppressing noises. Recently the sound truck and crew were established along a railroad right-of-way getting the sound of trains speeding by. Throughout the day a near-by cricket chirruped merrily, and his "voice" ran through all the train material with an effect that was far from the one expected.

The thrilling stampedes you see carry sound of hoof beats made on a movie ranch north of Hollywood. In the Warner Brothers library are sound effects representing from one to 300 horses. To get sounds of them milling around a field, horses were led in a circle around the microphone. To record a stampede, two microphones were set up 500 feet apart. Then 300 horses of the California National Guard walked, trotted, and galloped. This material can be used for western cattle stampedes, cavalry, or nearly any scene showing animals running, and the noise of which will add appeal to the picture.

SOUND engineers try constantly to improve the recordings, hoping for that day of perfection when lightning and thunder will startle audiences with their naturalness. That is, in fact, the one and only aim of sound technique in the movies. In the future all movie noise must be the real thing.

HIDDEN CRIME CLUES BARED BY CHEMISTS

(Continued from page 24)

hood. In a dark, damp cellar near the East River, they stumbled upon a chemical link which started a curious chain of evidence that ended with the slayer's sentence to the electric chair.

Pools of water, seeping in from a recent rain, stood about the dark dirt floor. One detective wet a thumb and forefinger, rubbed them together and looked significantly at his companion. The water had a slippery, oil-like feel. Samples were taken, analyzed at headquarters, and found to contain, in solution, large quantities of lye. The murderer had buried his victims in the cellar, covering them with lye to hasten their decomposition.

In one corner of the basement, the sleuths discovered a brown paper bag with figures penciled on one side that added up to a total of $1.98. Taking a chance that this slender clue might lead them to the murderer, they made the rounds of nearby merchants. In one chain store, a clerk recognized his own figures and recalled that a customer who had made purchases totaling that amount had bought ten cans of lye a few days before. His description led to the capture of the fiendish killer.

Among the recent weapons that chemistry has placed in the hands of the scientific sleuth are tear gas, allowing homicidal desperados to be captured without gunplay, and moulage, the strange colloidal substance which preserves in permanent form such perishable bits of evidence as footprints in dust, teethmarks in fruit and fingerprints in dough.

ANOTHER phase of the battle of chemistry against crime is the study of the invisible writing inks used by the underworld. The men who play a desperate life-and-death game with the law, I discovered, are turning to ingenious chemical combinations to carry their secret messages. The scientific detectives with whom I talked, including a secret service man who had trailed German spies in the World War, gave me scores of these invisible ink formulas. A few will show their wide variety.

Silver nitrate. Expose the paper to sunlight and the writing appears.

Chloride of cobalt. Apply heat to the paper to bring out the letters.

Lead acetate. Develop the unseen writing by exposing the paper to hydrogen sulphide.

Cobalt nitrate. To reveal the message, apply oxalic acid.

Common starch is sometimes used to write on linen. Fumes of iodine bring out the hidden words. At other times, highly diluted sulphate of copper is employed, writing with a soft toothpick between printed lines. The message is later developed with strong ammonia fumes.

One famous German spy formula consisted of one ounce of linseed oil, twenty ounces of liquid ammonia and one hundred ounces of distilled water shaken together. Used with a quill pen, the ink becomes visible when the paper is dipped in water and remains legible as long as it is wet. When the paper dries, the writing disappears, but it can be brought back at any time by rewetting.

EVERYDAY substances, such as table salt, fruit juices and common milk, are used for invisible inks by criminals in emergencies. Heating the paper by rubbing a hot iron over it brings out the writing. Hunted lawbreakers have been known to carry chemicals concealed in coat buttons and soaked into shoelaces for emergency use in secret writing.

In the field of visible inks, chemist-detectives can deter- *(Continued on page 141)*

HIDDEN CRIME CLUES BARED BY CHEMISTS

(Continued from page 140)

mine the approximate age of writing by simple reagent tests. Fresh blue-black ink, for instance, will smudge and the blue dye will run when it is treated with a two-percent hydrochloric acid solution. But the same writing, if it is several years old, will resist the action of the reagent. By similar tests, it is reported, two pieces of paper can often be proved to have come from the same roll, reagents showing the exact amount of wood-pulp impurities in them.

Such tests are sometimes packed with drama.

Four or five years ago, claimants appeared in a New England court with a will dated 1855. If sustained, it would give them title to a valuable business block in the heart of town. A desperate court battle ensued.

Experts from New York testified the paper upon which the document was written was of the type used eighty years ago in America—at the time the will was dated. Handwriting authorities declared the writing seemed identical with specimens found in old letters of the testator. Then, the defense attorney played a surprise card. He called an expert chemist to the stand. This scientist testified he had examined the ink chemically and had found coal-tar coloring present.

Opening an encyclopedia dramatically to "C," the attorney pointed out to the jury that it was not until 1856, *a year after the will was dated,* that the youthful English chemist, W. H. Perkin, made his accidental discovery of coal tar dyes. The swindlers later confessed they had skillfully forged the document with modern ink on old paper taken from the flyleaf of an early American book.

The number of such spectacular exposes, credited to chemistry in all fields of crime detection, is constantly increasing. So it is not surprising that the army that battles for law and order is giving special attention to its division of "chemical warfare."

1,000-POUND BLAST TESTS SCRAPPED WARSHIP

HALF a ton of high explosive was recently set off, on purpose, aboard the British battleship *Marlborough* during an unusual test. Since this coal-burning ship was about to be scrapped, military engineers took advantage of that fact to study the effect of an internal explosion such as might occur in war. They stowed 1,000 pounds of cordite in the forward magazine to simulate the effect of an enemy shell piercing the ammunition storeroom. All craft were warned to keep a quarter mile or more away, and the ship was moored in shallow water in case she sank. Then the blast was fired. But the *Marlborough* still floated. Experts with gas masks were able to plunge into the smoke-filled magazine to observe the explosion's effects. They found decks and bulkheads twisted, but the armor-plate unscathed.

WHITE SHIRT IN MOVIE IS REALLY YELLOW

WHEN you see the leading man in a motion picture dressed in evening clothes he is not wearing a white dress shirt and collar. Yellow ones have been found to photograph more realistically in the movies. The table cloth from which the actors dine is yellow, light red, lavender or blue. Directors have found it almost impossible to photograph starched white objects in making pictures, so they have substituted the colored effects.

AMERICA DRIFTING EQUATORWARD

(Continued from page 19)

of its west coast paralleled that of the eastern shore of America. He pulled Greenland 1,500 miles to the south. Its southern tip dovetailed with the Labrador coast on the west and the Scandinavian Peninsula on the east.

Could this be just chance, he asked himself, or was there some directing cause behind it? He pondered. As months went by, he became convinced that the story of those "jig-saw" coast lines was the story of one of the most dramatic events in the history of our planet. This, as he visualized it, is what had happened:

Eons ago, in a dim foreworld inhabited by strange prehistoric monsters, there were no great ocean gaps between America and Europe, Asia and Africa. Greenland fitted snugly into the notch between Newfoundland and Scandinavia. Australia nestled close against the east coast of Africa, and from the Southern sea an enormous Antarctica stretched northward to fill the breach between South America and the Cape of Good Hope. All the bodies of land were then joined together in one vast continent—mysterious Gondwana Land. Here prehistoric hairy elephants wandered from Labrador to Russia and camels strolled from China to Peru.

BUT monster Gondwana Land, like an extra weight on one side of a spinning top, made the earth lopsided. The whirling world careened through space struggling to balance itself and redistribute its mass. Under the terrific force of the spinning planet, racing 1,000 miles an hour, Gondwana Land broke into the several pieces we know as continents today.

Modern geologists are agreed that these continents rest upon an inner mass of molten material, forty or fifty miles below the crust. Floating on this molten inner layer, as icebergs float upon a sea, the continents gradually widened the distance between themselves until they reached their present positions.

This, in brief, is Dr. Wegener's theory of the past. But that is not all. The continents are still in motion, he declared; the room in which you read these words is like one of millions of cabins on the deck of a great raft—a raft that stretches for thousands of miles and is carrying cities and rivers, lakes and mountains in its slow drift on an invisible sea of molten rock!

Of course, such a startling theory was greeted skeptically by the conservative scientists of the time. Dr. Wegener said nothing, but set to work collecting his facts. In the end, he amassed evidence in the realms of zoology, botany, geology, and physics to support his hypothesis. Today, in various parts of the world, scientists of high standing give it serious consideration. Experts admit that it does not conflict with any established finding of geology; and the mathematics of the theory is entirely sound, according to Dr. Maris, who spent months at the Naval Research Laboratory with paper and logbooks, figuring the effect of molten masses, the thickness of the earth's crust, and the planet's rotational speed.

WHEN you are trying to solve a jig-saw puzzle, finding two pieces that fit together is not enough. They must also match in color. Similarly, in fitting the continents together, Dr. Wegener realized that finding coast lines that appear once to have been joined is insufficient. It might be the result of accident. So he went still further. He found in several places where the "colors" match as well.

For instance, the conformity between the rock strata on the South American coast and the African coast is remarkably similar. In the case of the Sierra Mountains in the province of Buenos Aires, Dr. Wegener discovered a remarkable fact. On enlarged maps, their broken ends, now 4,000 miles apart, match like the two halves of a torn visiting card.

Again, if you push geological maps of North America and western Europe together, he pointed out, black coal veins in one continent join black coal veins in the other, forming a continuous line. In at least five points on opposite Atlantic coasts, he discovered that geological formations jibe like the colors and pattern of two adjacent slices of layer cake.

THEN there is the evidence of the animals. Take that queer, long-nosed creature, the tapir. In the world today, there are five species of tapirs, all evidently from one common origin. Four of these species live in Central and South America. The fifth is found only in the Malay Peninsula and the nearby islands of Sumatra and Borneo—clear on the other side of the world. Monkeys, big spotted cats, and the camel tribe are likewise found on separated continents. The beautiful tropical bird, the trogon, is found only in the widely scattered continents of Asia, Africa, and South America.

Again, there are the marsupials, or pouch-bearing animals. Our opossum is the only living representative north of the equator. All others live either in South America or Australia. Vast oceans lie between these continents. Unable to migrate across thousands of miles of water, how did these creatures reach their far-flung modern homes?

"Land bridges" is an ingenious answer which many scientists accept. Narrow peninsulas in prehistoric times connected the continents, they say. Across these, animals and birds migrated to their present abodes. In answer to this, Dr. Wegener pointed to Madagascar.

On this island, only two hundred miles from the east coast of Africa, you would naturally expect to find animal life closely related to that on the African mainland. Yet, the curious fact is that the two animal populations differ more widely than do those of England and Japan, while there is a close connection between the reptiles of Madagascar and those of South America, 6,000 miles away!

Land bridges fail to explain that confusing fact, but Dr. Wegener's theory that Madagascar through countless ages has been a wandering island once connected to South America, and now, like a ship nearing port, approaching Africa, offers a solution to the enigma.

PREHISTORIC animals as well as living give strength to the theory. The forerunners of existing types, the extinct elephants, camels, and rhinoceroses are so generally distributed across North America and Eurasia that the logical assumption is that the continents once were joined.

In the highlands of the Scandinavian Peninsula, there lives a strange little rodent, the Arctic lemming. Periodically, the animals gather in great hordes, sweep down the mountain sides, overrun the farms, swim swift rivers, and, surmounting every obstacle, rush toward the sea. Wolves and hawks harry them. Farmers kill thousands. Yet they keep on. Reaching the coast, they plunge into the water and swim straight out into the ocean until their strength fails and they drown.

What strange madness grips these little animals? What *(Continued on page 143)*

AMERICA IS DRIFTING TOWARD EQUATOR

(Continued from page 142)

is the explanation of the suicidal mania that leads them on? Scientists have puzzled for generations over those questions. The peasants of Norway have the legend that the lemmings once inhabited the lost continent of Atlantis and swim away seeking their ancient homeland.

This, perhaps, is nearer the truth than most people suspect, according to Dr. Wegener's theory. Only 50,000 or 100,000 years ago, he calculated, Greenland was attached to the Scandinavian Peninsula. Then it broke away and began its slow movement to the west. Thousands of generations of lemmings were born while it moved off inch by inch.

When there was a food shortage or overcrowding, part of the animals migrated across the slowly widening gap to the other shore. For centuries this continued. Instinct led the rodents to head away from the coast even after the gap grew so wide that their strength was insufficient to carry them across. And even today, with Greenland more than 2,000 miles away, according to this explanation of the mystery, they blindly strike out into the open sea.

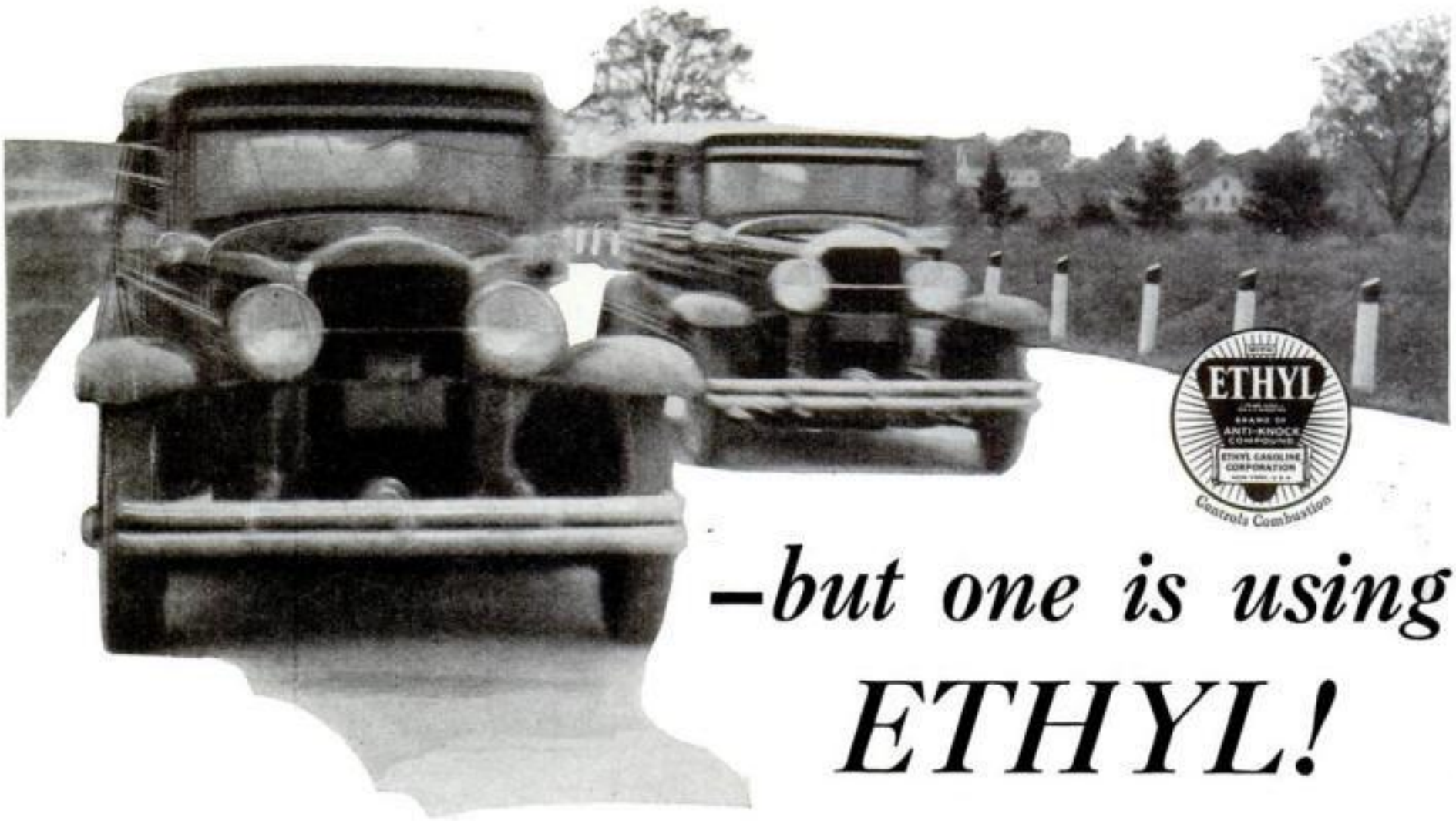
IN THE legends of nations far removed, there are frequent references to "lost continents." The Greeks and other early people told of a mysterious "Atlantis," that disappeared beyond the Pillars of Hercules; the Welsh of a legendary "Avalon"; the Portuguese of the long-lost, fabulous "Isle of the Seven Cities." Such scientific will-o-the-wisps flicker in the folklore tales of many lands, recounting supposed events in the dim ages before the beginning of written history. They may record, Dr. Wegener's adherents suggest, the remote memory of the race, a memory of long-ago catastrophes when continents broke apart and drifted away.

Long before Dr. Wegener formulated his hypothesis of continental drift, strange "errors," cropping up from time to time, puzzle geographers measuring remote parts of the earth for the purpose of accurate mapping. More than a century ago, Sir Edward Sabine, the British scientist, made observations of longitude in Greenland. In 1907, J. B. Koch, the German explorer, made similar observations at the same spot. He was nonplussed to find that the continent had apparently drifted westward more than a mile in the intervening eighty-four years. The puzzle was finally dismissed by conservative scientists who assumed that Sabine had made an error.

MORE recently, observers in Washington, Rome, Paris, Milan, and Greenwich reported that all these observatories had moved short distances toward the equator in the course of periods ranging from eighteen to fifty-six years. Then it was discovered that errors of refraction, due to the density of the atmosphere, had been ignored in the calculations and, in the end, the scientists concluded their own eyes might be responsible for the supposed change of latitude. But now the whole matter is again under discussion and a concentrated effort to clock the continent in motion is being made.

The evidence thus far gathered in support of Dr. Wegener's fascinating theory is largely circumstantial. He lost his life in an attempt to gather direct evidence, in an effort to time the movement of Greenland by the stars. The Williams Expedition, equipped with its special instruments, will soon penetrate the North on a similar quest for positive proof. Perhaps, when they return in 1934, their records will at last bring this proof of the strange theory of lands that drift on melted rock.

2 cars of the same make — the same model



—*but one is using ETHYL!*

IT'S a thrill to zoom ahead of the crowd when traffic lights turn green. But the faster pick-up Ethyl gives is more important than that.

When you are passing slow-moving trucks or other cars, the difference between quick and lazy pick-up is the difference between safety and danger.

Ethyl Gasoline gives your car all the pick-up the makers built into it because Ethyl Gasoline burns as smoothly under strain as it does when the engine is idling. It gives you power when you need it—*instantly!*

Ethyl Gasoline is *more* than gasoline. It's *good* gasoline *plus* Ethyl fluid. Inside the cylinder the Ethyl fluid *controls combustion*. Even under severe strain, Ethyl fluid prevents gasoline from going off in the uneven explosions that cause power-waste, harmful knock and overheating. It delivers the power of gasoline to the pistons with a smoothly increasing pressure that brings out the best performance and the maximum power of *any* engine.

Faster pick-up is only *one* of the benefits of controlled combustion. Your car will show you six others: (1) freedom from harmful knock, (2) more power on hills and heavy roads, (3) less vibration, (4) less gear-shifting, (5) a cooler running engine in the summer and (6) an easier starting engine in the winter. Fill up with Ethyl Gasoline and see for yourself. Ethyl Gasoline Corporation, Chrysler Building, N. Y. C.

THE LESS TIME you spend in the other fellow's lane—the safer you are. Ethyl Gasoline cuts down the time required for passing by giving you faster pick-up and greater power on hills. It gives you POWER when you NEED IT!

The active ingredient used in Ethyl fluid is lead

ETHYL GASOLINE

Put Yourself into the Picture . . .

. . . with a Face that's *Fit*

A MELLOW sun overhead. Crackling leaves underfoot. A good dog with his nose to the wind—and the smell of wood smoke in the air. Put yourself into the picture—alert and alive, with a Face that's Fit.

Put yourself into the picture *anywhere* with a Face that's Fit. It's a simple matter with Williams Shaving Service—Williams Shaving Cream and Aqua Velva.

Take that plump, white Williams tube in your hand. Squeeze it. Out comes a ribbon of snowy purity onto your brush. Stroke your face—and there you are, smiling behind a mask of luxurious lather. Amazingly mild. Pleasantly cool. A comfortable lather that's good for skin and beard. No grease to clog the pores—to clog and dull the razor. No after-sting. No dryness. Not an atom of dye in Williams Shaving Cream.

Finish with Aqua Velva . . . and it *is* the perfect finish for the perfect shave. Dash it on the moist skin. It's as tingly and bracy as the Autumn air. It wakes up sleepy tissues—firms them. Conserves the good-complexion moisture. Helps to care for tiny, unseen nicks and cuts. Sends you away from the mirror smiling—with your face well-groomed for the day.

In any season, in any land, millions of men know that Williams Shaving Service is the swift, sure way to Face Fitness.

WILLIAMS SHAVING LIQUID
Shaving lather in a very new form. Quick. Mild. Just shake a few drops from the man-style, blue bottle onto your brush. And there you are. Great, too, for a shampoo.

JUST NOTICE THE FINE SKINS OF MEN WHO USE

Williams

SHAVING CREAM—AQUA VELVA

MAIL THIS!
It will show you the way to Face Fitness

THE J. B. WILLIAMS COMPANY, Dept. P. S.-130
Glastonbury, Conn., U. S. A.
Canadian Address: 3552 St. Patrick St., Montreal

I am anxious to try Williams Shaving Service. Please send me trial sizes of Williams Shaving Cream and Aqua Velva.

.....

.....

.....

*Consider your Adam's Apple!!**

Don't Rasp Your Throat With Harsh Irritants

"Reach for a LUCKY *instead"*

Now! Please!—Actually put your finger on your Adam's Apple. Touch it—your Adam's Apple—Do you know you are actually touching your larynx?—This is your voice box—it contains your vocal chords. When you consider your Adam's Apple you are considering your throat—your vocal chords. Don't rasp your throat with harsh irritants—Reach for a LUCKY instead—Remember, LUCKY STRIKE is the only cigarette in America that through its exclusive "TOASTING" process expels certain harsh irritants present in all raw tobaccos. These expelled irritants are sold to manufacturers of chemical compounds. They are not present in your LUCKY STRIKE. And so we say "Consider your Adam's Apple."

Emily Boyle
BRONXVILLE, N. Y.

TUNE IN—The Lucky Strike Dance Orchestra, every Tuesday, Thursday and Saturday evening over N. B. C. networks.

"It's toasted"

Including the use of Ultra Violet Rays

Sunshine Mellows — Heat Purifies

Your Throat Protection — against irritation — against cough